

amateur radio

SEPTEMBER, 1974

**BLASTING AREA
SWITCH OFF RADIO
TRANSMITTERS**

**SPECIAL EMC
ISSUE**

CONTENTS

TECHNICAL —

Amateur Transmitter Interference to Tape Recorders, etc.	11
Audio Frequency Interference (AFI)	17
Commercial Kinks	22
Newcomers Notebook	21
Try This	21
TV Interference from HF Stations	10

GENERAL —

Diplomacy for Amateurs	10
Electronic Pollution — an impending crisis	8
EMP — The Ultimate EMC Problem	12
FM and 2 M Repeater Details	25
Interference Bibliography	20
Nothing New	26

DEPARTMENTS —

Awards Column	23
Book Review	23
Contests	23
Hamads	26
Letters to the Editor	24
Magazine Index	23
QSP	3, 7, 26
Silent Keys	26
VHF-UHF — an expanding world	22
YRCS	22

PHOTO
Sign evidence of a common EMC problem.

GRID DIP METER SPECIFICATION

Model TE-15

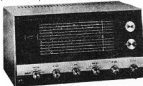
Freq. Range: 440kHz-280MHz
in 6 Coils
A Coil 0.44—1.3MHz
B Coil 1.3—4.3MHz
C Coil 4.1—14MHz
D Coil 14.4—40MHz
F Coil 120-280MHz
Transistor: 3 TR's & 1 Diode
Meter: 500µA F.s.
Battery: 9V (BL-005P)
Dimensions: 100x80x40mm
Weight: 730g

Price \$36.50
P & P \$1.00

LAFAYETTE HA-600A SOLID STATE

GENERAL COVERAGE

- 5 BANDS 150-400 KHz, 550-1600 KHz (Broadcast band), 1.6-4.3 MHz, 4.3-14.6 MHz, 10.5-30 MHz. Operates from 12 Volts DC (negative ground) or 220-240 Volts 50 Hz.
- Field Effect Transistors in RF Mixer and Oscillator Stages.
- Two Mechanical Filters for exceptional selectivity.
- Voltage Regulated with Zener Diodes.
- Product Detector for SSB/CW.
- Edge Illuminated Slide Rule Dial with "S" Meter.
- Continuous Electrical Bandspread Calibrated 80-1000 Amateur Bands.
- Variable BFO, Automatic Noise Limiter.
- Speaker Impedance: 4 to 16 ohms.



Price \$215.00

P & P \$2.00

Also available — HA800B Amateur Band, 6 Bands 3.5MHz to 29.7MHz and 50-54MHz as above features with 100kHz calibration facility: \$218.00, 100kHz Xtal Extra \$10.75. P & P \$2.00

SOLID STATE WIDEBAND RF SIGNAL GENERATOR

MODEL SG-402

This is an all solid state, wideband RF Signal Generator which produces low impedance low distortion RF signals. It is highly dependable and easy to operate, and is a handy working instrument for service benches and electronic equipment production centres.

SPECIAL FEATURES

- Generates wide range signals from 100kHz to 30MHz in six frequency ranges.
- All solid state construction for instant waveforms, compact and lightweight portability.
- Includes 400Hz signal source for modulation of output signal, which can be modulated by external sources.

Price \$99.50, p & p \$2.00

P.M.G. TYPE TELEPHONES—DIAL TYPE

EXTENSION

Ericsson Type manufactured by L. M. Ericsson. As used by PMG Dept. As new condition. Dial in base. \$19.50 Tested p&p 75c
Black Phone, Chrome Dial Standard type. Robust construction. \$7.95. Few only p&p 75c
Plastic Type, Standard PMK type. Manufactured by L. M. Ericsson. As new tested. All phones fitted with standard phone plug and socket. \$17.50, p & p 75c
Double Phone Plug, 6.5mm 75c
Standard 2 Circuit Phone Plug PMG Type 30c
PMG Type Counters, 4 digit, 48 Volt operation 50c
PMG Type Telephone Plug & Socket, round type. PMG Type Phone Plug & Socket, standard Ericsson Type White Plastic 85c per pair
PMG Type Telephone Extension Bells, 48V \$2.00
230 Volt RVB Horn Tested \$7.50



Model HE-22D

Model TE-22D

Freq. Range: Sin: 20Hz-200kHz
Square: 20Hz-25kHz
Output Voltage: Sine: 7 volt
Square: 7 volt
Output Impedance: 1000 ohm
Freq. Accuracy: $\pm 3\%$ $\pm 2\%$
Distortion: Less than 2%
Tube Complement: 6BM8
12 AT7, 624
Power Source: 105-125, 220-240V AC, 50/60 cps. 19W
With Attenuation Range
4 Ranges—1/1, 1/10, 1/100, 1/1K

Price \$49.50
P & P \$2.00

DELUXE AUDIO GENERATOR SPECIFICATION



Compact-Space Saving.
Printed Circuit for uniform Characteristics.
Low Distortion
Dimensions: 140 x 215 x 170mm
Weight: 2.8kg.

DX150B REALISTIC WITH SEPARATE SPEAKER



The popular REALISTIC DX150B which has gone from strength to strength with amateurs, short-wave and broadcast listeners alike, now has a further improvement. A SEPARATE MATCHING SPEAKER included.
The DX150B gives long-range, world-wide realistic reception on 4 bands, including Broadcast Fully transistorised all solid state-no warm-up delays, the DX150B will run on dry cells if current fails or is not available, will operate from a car's cigarette lighter or any 12V DC service. A 240V AC power supply is also built in. Over 30 semi-conductors-product detector for SSB/CW, plus fast and slow AVC-variable pitch BFO-illuminated electrical bandspread, fully calibrated for amateur bands-cascade RF stage-ANL for RF and AF-zener stabilised-OTL audio-illuminated "S" meter.

Price \$229.00
P & P \$2.00

new price — \$189.00

TRIO 3" OSCILLISCOPE DC — 1.5 MHz MODEL CO-1303A



SPECIAL FEATURES

- Vertical sensitivity of 20 mV/cm, three step attenuation, AC DC operation & wideband frequency response from DC to 1.5MHz.
- DC vertical and horizontal amplifiers for wide versatility make possible external sweep speeds of less than 1Hz.
- All solid state construction for compact, lightweight portability.
- Smoked filter glass CRT face and exclusive designed graticule, graduated in dB for clear waveform comparisons.
- Direct input to 150MHz for SSB and AM transmission monitoring.

Price \$150. p & p \$2.00

DISPOSAL SPECIALS

Coax. Cable, 58 ohm Ascand 15 P1/24. Brand new 1/2 outside diameter. 12c per yard. \$10 per 100 yard reel.

MARCONI
VIDEO OSCILLATORS
TF885A 30 KHz — 5 MHz
240 VAC operation P.O.A.

PLESSEY TRANSCEIVERS
in stock at present include
B47, B48, C42, C45 with power supplies and accessories also available.

Brand new valves and semiconductors

2N3055	\$1.00
OA91	15c
807	\$2.00
1T4, 6C8, 1R5	75c
6BA6-6AK5-6V6G-6J6	\$1.00
2E26-QQE04/7-QQE04/10	\$1.00
6SK7-ECH35-6K8G-5763	\$3.00
6SJ7GT-12AT7	\$1.50

HAM RADIO (Disposal Branch)

104 Hightest Street, Richmond,
Vic., 3121 — 42 8136

HAM

RADIO SUPPLIERS

323 ELIZABETH STREET, MELBOURNE, VIC., 3000

Phones: 67-7329, 67-4286 All Mail to be addressed to above address

Our Disposals Store at 104 HIGHEST ST., RICHMOND (Phone 42-8136) is open Mondays to Fridays, 10.30 a.m. to 5.0 p.m., and on Saturdays to midday.

amateur radio

JOURNAL OF THE WIRELESS INSTITUTE OF AUSTRALIA, FOUNDED 1910



SEPTEMBER, 1974

VOL. 42, No. 9

Price, 50 cents

Registered at the
G.P.O. Melbourne for
transmission by Post
as a Periodical—
Category "B"

QSP

**Electromagnetic Compatibility
Electromagnetic Interference**

Editor:
Bill Roper VK3ARZ

Assistant Editor:
Bruce Bathols VK3UV

Technical Editors:
Bill Rice VK3ABP
Ron Cook VK3AFW

Publications Committee:
John Adcock VK3ACA
Rodney Champness VK3UG
Syd Clark VK3ASC
Ron Fisher VK3OM
Ken Gillespie VK3GK
Neil Osborne VK3YEI
Howard Rider VK3ZJY
Roly Roper —
Giff Sones VK3AUI

Contributing Editors:
Brian Austin VK5CA
Deane Blackman VK3TX
Peter Brown VK4PJ
Eric Jamieson VK5LP

Drafting Assistant
Gordon Row L30187

Business Manager:
Peter B. Dodd VK3CIF

Enquiries and material to:
The Editor,
P.O. Box 2611W, Melbourne, 3001.

Copy is required by the third of each month. Acknowledgment may not be made unless specially requested. All important items should be sent by certified mail. The Editor reserves the right to edit all material, including Letters to the Editor and Hamads, and reserves the right to refuse acceptance of any material, without specifying any reason.

Advertising:
Advertising material should be sent direct to P.O. Box 150, Toorak, Vic., 3142, by the 25th of the second month preceding publication. Phone. 24-8652.

Hamads should be sent direct to P.O. Box 150, Toorak, Vic., 3142, by the 3rd of the month preceding publication.

Printers:
Chas E. Tully Pty. Ltd.
35 Clifford Street, Huntingdale, 3166.
Phone: 543 1242.

Published monthly as the official journal by the Wireless Institute of Australia.

Reg. Office:

P.O. Box 150, Toorak, Vic., 3142

It is doubtful if anyone fully comprehends the full impact on modern society or the interactions of all the technical, economic, social and political complexities resulting from the electromagnetic spectrum.

What is this electromagnetic spectrum? About one-half of all our telecommunications between fixed points, all radio and TV broadcasting, mobile communications, radar and radionavigation services are transmitted by radiation at various frequencies of the electromagnetic spectrum. It is a national resource which costs nothing to use and yet its value at any given time can be drastically reduced by misuse. It is a resource which must be shared nationally and internationally and is absolutely irreplaceable in our present way of life.

Although the electromagnetic spectrum theoretically stretches through many decades of frequency, it is, unfortunately, a limited resource since only a microscopic part can be utilized within the bounds of today's technical know-how. About 80 per cent of the present uses of the spectrum have come about since World War 2.

In short, we are running out of usable spectrum and the proper management of it is of extreme importance.

Part of this management centres around control of equipment design in aspects of Electromagnetic Interference and Electromagnetic Compatibility.

Electromagnetic Interference (EMI) may be defined as causing a degradation in performance of an equipment as a result of its susceptibility to internally generated interference or external fields and voltages generated by other causes. Thus an equipment may be either Radiation Susceptible (RS) or Conduction Susceptible (CS), or it may cause interference in which case the emission may be Conducted Emission (CE) or Radiation Emission (RE).

Electromagnetic Compatibility (EMC) may be defined as the ability of equipments to function without degrading the performance of other equipments by EMI. The two terms EMI and EMC clearly therefore should not be regarded as separate problems but rather as interdependent.

Equipment subject to EMI and EMC may be classified as:

a. Communication-Electronic (C-E) equipment which includes:

- (1) Receivers using antennas;
- (2) Transmitters using antennas; and
- (3) Non-antenna C-E equipment (such as counters and test equipment).

b. Non-Communication Equipment which includes:

- (1) Non C-E equipment in which RF energy is intentionally generated for other than information or control (such as ultrasonic equipment, medical diathermy equipment and uninterruptible power supplies);
- (2) Electrical equipment such as electric motors in all types of appliances; and
- (3) Accessories for engines and vehicles such as alternators, gauges and windshield wipers.

c. Vehicles and engine driven equipment.
d. Overhead power lines.

EMI is a form of pollution as serious and widespread as other forms. Its presence is apparent in many ways and its seriousness has long been recognised. It has two main causes. The first is unacceptable radiation or conduction at other than the required frequency by electronic equipment such as communications transmitters and radar sets. The second is wide-band random emission by all types of electrical and electronic devices.

The level of EMI/EMC design knowledge in Australia is generally low by overseas standards and being, as it is, as much an art as a science, considerable experience is required before personnel become proficient in this field.

Here then is another challenge for the amateur.

John McL. Bennett, VK3ZA

BOOKS OF INTEREST FOR AMATEUR OPERATORS

Babani—THE SECOND BOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES	\$3.10
Babani—THE HANDBOOK OF INTEGRATED CIRCUIT EQUIVALENTS AND SUBSTITUTES	\$2.50
De Muiderkring—TRANSISTOR EQUIVALENTS	\$4.95
Ball—RADIO VALVE AND TRANSISTOR DATA, 9th Edition	\$2.70
Frost—HOW TO LISTEN TO THE WORLD	\$4.95
Jorgensen—HANDBOOK OF MAGNETIC RECORDING	\$4.95
Ham Radio—HAM NOTE BOOK	\$4.20
Gaddis—TROUBLESHOOTING SOLID STATE ELECTRONIC POWER SUPPLIES	\$4.60
Goodman—199 COLOUR TV TROUBLES AND SOLUTIONS	\$5.10
W. Oliver—HANDBOOK OF SEMI-CONDUCTOR CIRCUITS	\$6.60

ADD POSTAGES: LOCAL 45c
INTERSTATE 75c

McGILL'S AUTHORIZED NEWSAGENCY

Established 1860

187-193 ELIZABETH STREET, MELBOURNE, VIC., 3000

"The G.P.O. is opposite"

Phones 60-1475-6-7

BRIGHT STAR CRYSTALS

- PROMPT DELIVERY GUARANTEED
- ALL TYPES OF MOUNTINGS

Such as HC6/U (style D) . . . HC18/U (style J) . . . HC25/U (style K) . . .
etc. . . Frequency range up to 140MHz on 5th overtone.



- ACCURACY
- STABILITY
- ACTIVITY
- OUTPUT

Our increased production now enables us to offer Special Discounts from 10%
Let us quote you for all your Crystal requirements.
Our easy-to-read Price List is now available.

BRIGHT STAR CRYSTALS PTY. LTD.

35 EILEEN ROAD, CLAYTON, VIC., 3168. Phone: 546-5076 (Area Code 03).

INTERSTATE AGENTS:

Sydney: PARIS RADIO ELECTRONICS, 7a Burton Street, Darlinghurst, N.S.W.
2010, Phone: 31-3273.
Perth: W. J. MONCRIEFF PTY. LTD., 176 Wittenoon Street, East Perth,
6000, Phone: 25-5722, 25-5902.
Brisbane: FRED HOE & SONS PTY. LTD., 246 Evans Road, Salisbury North,
4107, Phone: 47-4311
Adelaide: ROGERS ELECTRONICS, P.O. Box 3, Modbury North, S. A.
5092. Phone: 64-3296.



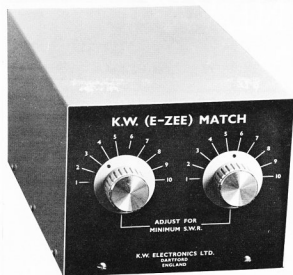
IC AUDIO AMPLIFIERS

10 watt	\$6.10
25 watt	\$15.90

Excellent specs
suitable for
stereo, PA, etc.

TECHNOLOGY PRODUCTS

66 MILTON PARADE
MALVERN, 3144
Phone: 20 7839



KW E-ZEE MATCH, an efficient coupling unit of the Z match type for use from 80 to 10 metres over a wide impedance range. For use with balanced or coaxial feed lines at up to 1KW PEP. **\$58**



KW-107 SUPERMATCH, an all in one unit, combines an E-ZEE match, Antenna switch, Dummy Load and SWR/PWR meter for balanced or coaxial feeds. Wide impedance matching range at up to 1KW PEP. **\$159**

ALSO AVAILABLE:

KW-160, an "L" network coupler especially for 160M, can also be used right through 80 & 40 for single wire or co-ax feed. Similar size and appearance to the E-ZEE. **\$48**

KW-109, Higher power version of the KW-107, same size but employing higher voltage condensers and heavier coils. **\$195**

KW MULTIBAND antenna traps. Comprises two special trap coils, ceramic centre "T" insulator and instructions for a 108 ft. 80-10M dipole, using co-ax or twin 70 ohm feeder. **\$22**

KW BALUN, ferrite 1:1 suitable for 50 or 70 ohms, lightweight and waterproof, has screw terminal connection. **\$12**

KW-103 SWR/power meter, toroidal pick-up type for accuracy and reliability, 0-30 MHz. A quality unit. **\$42**

KW DUMMY Load, air cooled, up to 1 KW, 0-70 MHz, 52 and 75 ohm. **\$28.50**

KW ANTENNA Switch, 3 position co-ax switch with UHF type teflon connectors, usable up to 500 MHz, 1 KW PEP, cross-talk better than -80db. **\$17.50**

KW-108 MONITORSCOPE, connects in antenna line for visually monitoring your transmission. Includes built-in two tone oscillator. **\$159**

KW2000E, 160 — 10M transceivers; Barlow-Wadley XCR-30 receiver, AM/FM digital clock radios; A comprehensive range of Hy-Gain, Newtonics, Cushcraft and Asahi antennas; SWR meters; Rotators; Morse Keys; Digital clocks, etc.; Plus, of course, the full range of Yaesu Musen transceivers, transmitters and receivers.

The items on this page are but a few from our large and still growing range of accessories. If the accessory you require is not shown on this page then call us or our agents, we're sure to have it.

All prices include S.T.; freight extra. Prices & specs. subject to change.

PRICE CORRECTION

The price of the **YAESU MODEL 620** in the Insert last month should be **\$368**. Please alter your copy.

THE AUSTRALIAN YAESU AGENT:



ELECTRONIC SERVICES

60 Shannon St. Box Hill North, Vic., 3129.

Ph. 89-2213

QLD. MITCHELL RADIO CO. 59 Albion Road, Albion, 4010
N.S.W. STEPHEN KUHLE P.O. Box 56, Mascot, 2020

Ph. 57 6830

Ph. Day 667 1650

A.H. 371 5445

S.A. FARMERS RADIO PTY. LTD. 257 Angus Street, Adelaide, 5000.

Ph. 23 1268

W.A. H. R. P. DE. 26 Lockhart Street, Como, 6152.

Ph. 60 4379

INOUE NEWS

■ **CUSTOMS REQUIREMENTS.** As mentioned last month VHF equipment is now treated the same as HF insofar as Customs is concerned. Hopefully, this will enable us to maintain 'off the shelf delivery' for equipment like the IC22, IC60 and the IC21A.

■ **NEW EQUIPMENT**
The IC21A 2 FM base/mobile unit is now available and replaces the IC21 which was featured in our 'AR' March advertisement.

A few of the new features are:—

- Variable RF output .5-10 watt.
- Switchable wide and narrow deviation.
- One range switching for 24 channels.
- Automatic PA tune.

It can be operated with a new external digital VFO covering each 2 MHz section of 2 metres. Channel separation is switchable into 10, 25, or 30 KHz, and can scan the whole band with either simplex or duplex channel frequencies. We should have prices and further details by the time this appears.

■ **6 METRE SSB.** Also in the works is a new 'handy' 6M portable SSB Transceiver. Just the thing to use with your friends with the IC501!

■ **2 METRE SSB.** Production of the 2M SSB Transceiver has been delayed, but we expect samples late November — keep in touch.

■ PRICES

IC22 with all accessories and 2 channels of your choice

\$198.00

Extra channels at time of ordering

\$5.00 T/R (Pair)

Additional channels at any time

\$5.50 T/R (Pair)

IC21A with 3 channels AC/DC

\$280.00

IC60 6 FM mobile with 3 channels

\$220.00

For the UHF types, the IC30 mobile and IC31 base units bear investigation. Write us for details or better still, an order with 20% deposit!

IC30 **\$370.00**

IC31 **\$385.00**

MAICO ELECTRONICS

A **textron** COMPANY



Mount St., Heidelberg, Victoria, 3084. 45 2615

FOR YOUR—

YAESU MUSEN

AMATEUR RADIO EQUIPMENT

in

PAPUA-NEW GUINEA

Contact the Sole Territory Agents—

SIDE BAND SERVICE PTY. LTD.

P.O. Box 795, Port Moresby

Phones 53557, 55511



For Reliable Connections

OTL

RESIN CORE SOLDERS

O. T. LEMPRIERE & CO. LIMITED



Head Office: 31-41 Bowden St., Alexandria, N.S.W., 2015
and at Melbourne, Brisbane, Adelaide, Perth, Newcastle

"WILLIS" AIR-WOUND INDUCTANCES

Take the hard work out of Coil Winding, use — "WILLIS" AIR-WOUND INDUCTANCES

No.	Di. Inch.	Turns per Inch	L'gh Inch	B. & W. Equiv.	Price
1-08	1/2	8	3	No. 3002	88c
1-16	1/2	16	3	No. 3002	88c
2-08	5/8	8	3	No. 3006	\$1.06
2-16	5/8	16	3	No. 3007	\$1.06
3-08	3/4	8	3	No. 3010	\$1.28
3-16	3/4	16	3	No. 3011	\$1.28
4-08	1	8	3	No. 3014	\$1.42
4-16	1	16	3	No. 3015	\$1.42
5-08	1 1/4	8	4	No. 3018	\$1.58
5-16	1 1/4	16	4	No. 3019	\$1.58
8-10	2	10	4	No. 3907	\$2.29

Special Antenna All-Band Tuner

Inductance

(equivalent to B. & W. No. 3907 7 inch)

7" length, 2" dia., 10 T.P.I. Price **\$3.96**

Reference: A.R.R.L. Handbook, 1961

Stockist of Transmission Cables, Insulators

and Hard Drawn Copper Antenna Wire

Write for range of Transmission Cables

WILLIAM WILLIS & CO.
PTY. LTD.

Manufacturers and Importers

77 CANTERBURY RD., CANTERBURY

VIC, 3126

Phone 836-0707

QSP

The signal reproduced here speaks for itself, and no doubt those WICEN operators who listened for the Quest will be pleased to know that their efforts were officially appreciated. Although the vessel was found eventually not to have been in distress, apart from a battering by heavy weather, the exercise served to point up some of the strengths and weaknesses of the present WICEN organisation.

When Quest failed to meet her sked on ship-shore frequencies, and the Marine Operations Centre was advised that she had amateur radio gear on board and might call for help on 14 MHz, the centre had no formal procedure for requesting a listening watch by amateur operators. It happened that the officer on duty was a retired Commander, RAN, personally acquainted with VK3CDR and aware that the latter is still a serving naval officer and accessible through the Defence communi-

cations system; it was also fortuitous that VK3CDR is a member of WIA Executive and was in a position to alert eastern States' WICEN networks with minimum delay.

In this rather minor call-out, the "Old Boy" net operated more effectively than such official arrangements as exist. This in itself is no bad thing; the one great advantage WICEN has over professional emergency services is the way our hobby permeates the whole community, so that amateur radio operators can be found in almost any organisation or walk of life. Nevertheless there is a demonstrable need to maintain an effective formal framework and to improve liaison with other emergency instrumentalities, especially in the Federal area.

A successful approach has already been made to the Director General of the National Disasters Organisation, and Executive is now reviewing the Federal structure of WICEN. As our strength lies in local community effort there is no intention on the part of Executive to interfere in the internal affairs of State networks; however it is palpably necessary to re-

ROUTINE 270113Z JUL 74
FROM: MARINE OPERATIONS CANBERRA
TO: DEFNAV CANBERRA
BT
UNCLAS
FOR SURGEON CAPTAIN LLOYD,
MELBOURNE.
1. NEW ZEALAND VESSEL WAIKARE/ZMCT
REPORTED SIGHTING QUEST AT 262100Z
IN POSN 3448S 17024E COURSE APPROX
080 TRUE UNDER STEAM AND SAIL.
2. YOUR ASSISTANCE IN ALERTING HAM
RADIO STATIONS AND OPERATORS TO
ASSIST IN THE SEARCH FOR OVERDUE
VESSEL GREATLY APPRECIATED.
3. IT IS REQUESTED THAT YOU PASS ON
TO ALL CONCERNED OUR THANKS FOR
THEIR CO-OPERATION.
BT
END UNCLASSIFIED
ACTION MDG

activate the position of Federal WICEN co-ordinator, and to define lines of communication with and between Divisional co-ordinators.

Jim Lloyd, VK3CDR

JOYA 1974

Please do not forget the 17th Jamboree on the Air on 19th/20th October 1974. It begins at 00.01 Local Time on Saturday 19th and terminates 48 hours later, but stations can operate from the Friday evening if more convenient.

TREES AS AERIALS

The Editorial in Ham Radio for May '74 gives brief details of US Army researches into the use of trees, light standards and other objects as antennas through the use of a flexible, toroid-shaped hybrid electromagnetic antenna coupler called a Hemac which is formed in a circle around the tree. "A 100-foot tree, for example, works best in the 80 metre range. Who will be the first to put this idea to work on Field Day?"

USA NOVICE LICENCE EXAM

"When the amateur Novice licence was first issued over 20 years ago, almost any applicant with no previous electronic knowledge could pass its writ-

ten examination after reading the questions and answers in Novice study guide a few times without understanding anything he memorised. But not today! Today, trying to pass the Novice written exam simply by studying the questions and answers of the appropriate study guide is doomed to failure on at least the first or second attempt, unless the student already has a pretty good electronic background. The difficulty is that the study guides supply the facts upon which the examinations are based, they do not supply the explanations necessary to understand the facts". From Novice Shack in CQ May '74. Another snippet from the same column reads "The good news is that there is still no fee for the Novice licence" (the basic amateur licence fee was quoted as \$10.00 and the CB licence fee is \$25.00).

WHAT IS AMATEUR RADIO?

"What Fred Laun's (LUSHFI, ex HS3AL etc.) Kidnappers (in Argentina) may have perceived as a

threat to them, was in fact a hobby used by thousands of men, women and children around the world as a means of promoting friendship and understanding. To the terrorists (who) kidnapped him all of this (amateur gear) may have been seen as some sort of clandestine operation designed to pass along information about their guerrilla operations." Quotes from a quote in Zero Bias CQ May '74.

NEW CALL SIGN PREFIXES

Radio Communication June '74 carries the information that the ITU have provisionally allocated call-sign series as follows — Bahrain ASA—ASZ and Cyprus (Republic) CAA—CAZ.

"CITIZENS BAND"

"The president of the United CBers of America has been jailed for 18 months and the UCBA fined \$500 following conviction on 11 counts of violation of FCC rules and other illegal activities." Radio Communications June '74.

INVENTIONS

Pat Hawker, G3VA, in his TT column Radio Communications June '74, quotes from his reading a booklet "Understanding creativity — a lightning course for executives" by Jack Nickle Smith: "He points out that if you suggested that inventive genius is a combination of intense concentration and pure logic many people would believe you. In practice it is more often the exact opposite. Logic sticks to the rules and inhibits new ideas. This is not to say that orthodox minds are not necessary to society. But innovation is finding a new, creative solution to a problem; not all problems require such solutions, some can be solved logically but these are not the really great innovations Rather than "an infinite capacity for taking pains" a genius has "an infinite capacity for curiosity and daring thought". Innovators need comprehensive knowledge of their subjects, but not disciplined knowledge."

IARU PRESIDENT

"IARU Vice-President Noel B. Eaton, VE3CJ, was formally elected president of the IARU — the seventh since the Union was organised at Paris 49 years ago". QST June '74.

TABLE OF FREQUENCY ALLOCATIONS

10 kHz to 275 GHz
A new booklet is now available from the Radio Branches of the PMG's Department which lists all the Australian allocations for the entire usable spectrum. It is a very comprehensive publication and will assuredly interest all those who may need reference material on this subject. The price is 50c (better add 15c for postage) and the WIA copy was obtained from Central Office.

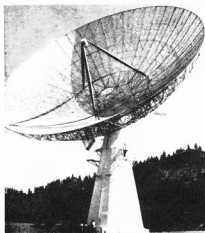
Shortly after Mrs. Whitlam opened the Townsville Pacific Festival she inspected the TARC display. Eventually she took the microphone and spoke to several VK3 stations.



Electronic Pollution - an impending crisis

By WEBB GARRISON

Reproduced from Popular Electronics, April 1973



AN ENVIRONMENTAL FACTOR THAT IS OFTEN OVERLOOKED

"The electromagnetic spectrum is one of our major natural resources. For decades, we have been taking it for granted. We can no longer afford the luxury of such an attitude; there must be a clean-up in spectrum pollution." Environmentalists who did not fully understand what he meant applauded the 1968 address in which FCC Commissioner Robert E. Lee made his plea. Engineers who did understand him agreed that the EM spectrum deserves to be ranked with air, water, and other resources. Most experts, however, took a dim view of the possibilities of a quick clean-up even in the limited part of the spectrum that includes the r-f band.

Today, matters are far worse than they were in 1968. Unexpected effects are becoming increasingly common:

■ En route from Miami to San Francisco, a jetliner's navigational system suddenly indicated that the plane was headed for Mexico City.

■ A banker wearing an implanted cardiac pacemaker nearly died when he stood close to a commercial microwave oven, and a woman using a similar device was thrown into cardiac crisis by diathermy equipment near her hospital room.

■ A Colorado businessman (who should have known better) used properly functioning equipment operating on a licensed frequency to call his office by radio from a construction zone: three members of a work crew narrowly escaped death in the blast and rock slide he triggered.

■ Radar systems of a major airport went haywire due to uncontrollable disturbances. The trouble began on Christmas Day. "Now we've learned to expect an annual battle with interference from toy walkie-talkies. Thank God those things break after a few weeks", said an FCC engineer.

■ Memory banks of a big Louisiana computer system were crippled when stored information was suddenly erased by radar from a nearby airport.

And so the list goes on and on, pointing up a rapid growth and continued increase in a form of pollution environmentalists often do not even cite. In the U.S. alone, the FCC receives about 1000 complaints per week about interference. Worldwide, the electromagnetic spectrum is becoming unbearably crowded. Simultaneously, proliferation of highly sophisticated electronic devices is multiplying the probability of your receiving unwanted inputs.

The 1971 international symposium of the Institute of Electrical and Electronics Engineers that was held in Philadelphia zeroed in on this problem. Robert D. Goldblum, a supervising engineer at General Electric's Re-entry and Environ-

mental Systems Division, spoke for 500 scientists and engineers from seven nations when he said: "With thousands of radio, television, and radar transmitters throughout the world beaming electromagnetic radiation through the air almost constantly, we are literally polluting the electromagnetic spectrum".

NOISE

During the early days of radio and telephone communication, acoustic filters were numerous and troublesome. It was natural to call such disturbances "noise", and to extend the label to cover electric waves that produced them. Today, interfering waveforms that do not have audible output are encountered in many systems. But "noise" remains the most common name for any kind of interference.

Much noise in a communication system is internal. Some is thermal. Other effects stem from electrons travelling from a heated cathode toward an anode. Such noise is of vital importance in communication, but pollution of the EM spectrum stems from noise caused by radiation external to the systems affected. Much of it is due to natural processes. But man's additions are constantly growing.

International Q signals used to describe r-f interference label nature's noise QRN. At first considered to be rather simple in nature, QRN is now known to be enormously complex. Beyond both ends of the radio band, waves create effects unknown to early radio pioneers.

Atmospheric static is believed to be linked with electrical discharges that take place between water droplets during turbulence. It is especially strong in the AM broadcast band but also affects the VHF band used for TV and FM. Current tests

indicate that rainstorms produce broadband noise that extends deep into the microwave region.

Solar flares sometimes cause widespread disruption of radio service. But many faint signals that reach our planet come from more distant sources. Cosmic rays, X-rays from galactic sources, and infrared light shower down on us from every part of the universe.

Radio astronomy was born as a result of studies aimed at reducing noise in telephone conversations sent across the Atlantic by radio. Karl Guthe Jansky of Bell Telephone Laboratories hooked up a 100-ft antenna to study noise. One night in 1932, he picked up a new sound that was somewhat like a faint hissing. Eventually, he identified the source — it came from the stars. Since then, it has been discovered that various types of celestial bodies emit so many different kinds of radiation that most or all of the EM spectrum is affected.

MAN'S CONTRIBUTIONS

QRM — man-made electrical noise — is often called "grass" by radar operators. TV engineers complain about "birdies" and "glitch". Along with a bevy of other man-made effects, these constitute electromagnetic junk.

Motors were the first devices to yield radiant trash. Today, a multitude of household and industrial appliances, from electric shavers to arc welders, produce radiant energy as side effects of their operation.

Medical equipment got into the act at least as early as 1905, a decade after Roentgen discovered X-rays. Abundance of X-ray, diathermy, and other machines causes a modern hospital to literally pulsate with radiant energy. Most of it does no harm, but any day, any burst of radiation can create emergency-level noise if it happens to fall upon a system capable of receiving it.

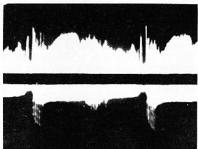
Communication would return to the era of the carrier pigeon if we suddenly stopped using enormous quantities of radiant energy to convey signals. But the proliferation of radio transmitters is a major factor in the production of electronic pollution. In 1949, there were 160,000 transmitters operating in the U.S.; today, there are 36 times as many.

No one knows what happens to individuals whose electrical processes are affected by radio and TV transmission. But Britain's respected journal *New Scientist* has pointed out that a 1.25-megawatt station dispenses so much radiant energy that the daily bombardment one mile away is sufficient to lift the family car 2 ft off the ground. Irrelevant? Not according to growing evidence. Quotes *New Scientist*, "There is some connection between chronic exposure to certain radio frequencies and a wide range of physical and

mental disorders".

About all we know positively is that some human organs are more susceptible to radiation damage than are others. "Practically speaking", points out Robert Goldplum in the 1970 edition of *ITEM*, "the human body is a three-dimensional mass having width and depth, as well as height. Therefore, when a man stands erect in an r-f field, he represents an object whose height, width, and depth dimensions can be expressed in terms of wavelength. When the body is so oriented that any of these major dimensions is parallel to the plane of polarisation of the r-f energy, the effects are likely to be more pronounced than when the body is oriented to other positions."

Transportation is more obscure than communication in its role as an EM pollutant, but it is highly important because whenever a spark occurs, a radio signal is generated. Many ignition systems radiate staccato-like bursts of noise over a broad range of the r-f band. Radar, now vital to forms of transportation ranging from measurement of highway speeds to observation of aircraft, emits its own kind of radiant energy at constantly increasing levels.



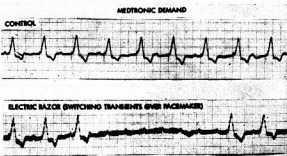
Power-line noise present on visual carrier (TV). (Photo courtesy IEEE)

MAN'S FURTHER CONTRIBUTIONS

Lights of various kinds emit enough radiation outside the wavelength of visible light to be considered serious pollutants. Few ordinary sources of electronic noise give TV receivers more trouble than does a flickering fluorescent tube. Neon advertising signs and other signs that use gases can create a virtual EM blackout for hundreds of yards in every direction.

Nuclear blasts at high altitudes yield radiant energy that interferes with some radar frequencies. Called the "Argus Effect" because it is reminiscent of the Greek creature with 100 eyes, it is being studied as a possible technique for rendering blind enemy radar. And electronic countermeasures (ECM) devices are constantly being developed, adding to the pollution problem.

Microwaves, first put to practical use in World War II radar installations, offer some hope, plus new dangers. Today, microwave relay towers dot the countryside of every advanced nation. With at least 50,000 general-purpose computers



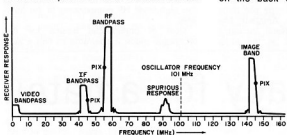
Curve traces show how interference from electric razor affected pacemaker. ("British Heart Journal")

operating in the U.S., it is inevitable that microwave transmission of data will show a dramatic increase within this decade. But microwaves are not limited to the field of communication. They do everything from curing plastics and lumber to warming and cooking food. Relatively innocent as sources of noise during the early years of use, microwaves have now been indicated on many counts.

TV DETECTIVE

More than any other common electronic device, TV receivers reveal pollution. Much of this noise stems from too strong signals. Such interference is a nuisance, but it is not a hazard. However, it points up the complexity of the problem.

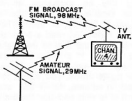
Practically all common sources of EM radiation produce characteristic and readily identifiable patterns of visual disturbance.



TV receiver tuned to channel 2 (54 to 60 MHz) has potential for picking up noise from four additional bands of frequencies. (Photo: RCA "Consumer Electronics & Commercial Systems")

Mild r-f interference creates a cross-hatched or basket-weave pattern. Diathermy creates moving ripples, herringbones, and similar effects. Power-line noises that can originate at any or all of five sources in normal cable suspension hardware creates pulses that can stop any show. Spark plug interference, usually random, causes fleeting but conspicuous spots. Boats and motorcycles cause much more trouble than do cars since their plugs are less heavily shielded.

Transmitters often radiate energy of



Two signals add or subtract to equal frequency of TV channel (98—29=69).

several different frequencies with receivers that can frequently pick up two or more frequencies. This factor, coupled with the multiplicity of external sources of noise, makes the chart of sources of TVI too complicated for beginners to read. Every time a TV receiver reveals interference, it can be taken for granted that dozens or hundreds of unseen events are occurring simultaneously. Electromagnetic interference is usually intermittent in a given case. But at any instant, it is taking place wherever electronic devices are being used.

AN UPHILL BATTLE

In the war against electronic pollution, progress is being made. But EM interference sits on the shoulders of the electronic age like the Old Man of the Sea on the back of Sinbad the Sailor. With

each forward step, the burden becomes heavier.

Upgrading specifications for colour TV receivers has about eliminated excessive X-rays — from properly functioning equipment. Tighter control over manufacturing standards has produced microwave ovens that pose no threat to wearers of cardiac pacemakers — providing that the door seals of the ovens remain factory-fresh.

Passengers on jet airplanes are no longer permitted to operate FM radio receivers during flight; they can wreak havoc on navigational equipment. Radio-controlled model airplanes have been outlawed in many cities for obvious and not-so-obvious reasons; one manufacturer, Champion, has spent a fortune developing a resistor spark plug that minimises noise. Too, the FCC is making a real effort to crack down on broadcasters who do not adhere to assigned frequencies.

Meanwhile, the tide of pollution mounts. Gains are more often than not offset by the continuing upsurge in the number and kinds of equipment transmitting or receiving.

ing r-t and microwaves. Deliberate jamming is a growing international problem, as is radio and TV piracy.

Most domestic interference is unintentional, but it may occur whenever the right conditions are found. Every increase in radiated EM energy has potential for creating new problems.

Largely unexplored biological effects of EM radiation are so vast that in some circles there is serious talk of trying to leadshield homes and offices close to powerful transmitters. With the microwave communications industry already billed as the "next big glamour field on the investment horizon", there is little doubt that

radiation will increase faster than protective measures can be taken and applied.

Interference now pollutes the spectrum so badly that the man on the street faces an impending global crisis. There is no real hope that interference can be eliminated. The best we can do is try to keep it at tolerable levels.

TV Interference from HF stations

R. S. GURR, VK5RG/T

9 Richmond Avenue, Daw Park, 5041

Standard TV aerial installation techniques utilise balanced feed systems, and care is taken to twist the feedline as it runs down a tower on standoff insulators. It is difficult to see how such a well balanced system would pick up even a little HF energy. The balance condition however is often destroyed at the TV tuner, where there may be unbalance introduced. The capacity from each 300 ohm tuner terminal to ground for instance is not always equal.

The unbalance introduced helps put large HF voltages (nearby Police, Amateur, Flying Doctor and Bushfire Nets) including spark plug ignition noises, at the tuner

thereby causing overload — intermodulation conditions to be established.

We can overcome these conditions often with the connection of a three or four turn coil of wire across the TV aerial terminals, whereby the HF signals are shorted out, leaving the VHF relatively unattenuated. Unbalance could still prevail, however.

The idea of isolating the balanced feedline from the unbalanced TV receiver was first tried with 300 ohm to 75 ohm baluns used back to back. The effect was so noticeable, that the need for a High Pass filter became redundant. Ignition noise reduction was the most beneficial property of this method, due to the elimination of the high level HF components in the feedline.

Cost of commercial baluns for this technique made it desirable to find a suit-

able alternative, and the practical way appeared to be to use one balun if possible. The simple means was of course the obvious — use a 1 to 1 isolation transformer — one whose losses were great at HF but low at VHF.

A Neosid Two hole ferrite TV balun core (such as sold by the Components Division of the WIA.—Ed.) is wound with two turns primary and two turns secondary of 10/0.0076 plastic hook up wire, with short tails left for connection to receiver and aerial. The result is so successful, even HF ham interference to a TV receiver using an indoor helical aerial is cured.

When I first made one of these for my own TV set, I was able to remove a 20 db resistive attenuator and a high pass filter that were used to overcome interference 10 years ago.

Diplomacy for amateurs

R. S. GURR, VK5RG/T

9 Richmond Avenue, Daw Park, 5041

No candidate at an A.O.C.P. or A.O.L.C.P. exam is asked to demonstrate his manners, temperament or tolerance. He is not questioned on his knowledge of the latest profanities — it is apparently assumed by the examiners, that he, being human, is psychologically suitable to have a licence.

Little surprise to anyone, when, one evening whilst working a new rare one, a previously unknown neighbour knocks, and suggests he get off the so and so air. Our 100 per cent mature diplomat will of course reply, "Yes mate, I will and may even volunteer to fix the problem!"

Most hams today are happy enough to keep up with the technology of their own rigs, and are entering new fields when they undertake to look at a neighbour's TV,

Radio or Record Player. In 99 per cent of cases, touch that set, and you are on for a free service contract for life!

A recommended way to respond to a neighbour is, "Yes, I will get off the air; however, I would like to continue to use my equipment tomorrow. Do you have any objection to my calling in a PMG Radio Inspector to do some tests". With a reply like that to indicate he has won his point, neighbour invariably says, "Yes". Following this an exchange of names, nature of trouble, etc., can be made. NEVER admit liability or fault. The ham should now watch TV, read a book or play with the kids for the rest of the night. The following day call in a Radio Inspector for an early opinion on the problem.

If your rig is crook, you ought to hang your head in shame, fix it and shut up about it. If it is not, and the trouble is the other fellow's receiver, let the PMG Inspector break the news to him. If it is

caused by outside influences, this is also not your responsibility unless the rusty joints, etc. are on your property.

Can you imagine the unfriendly atmosphere you will create if it is you, yourself, who condemns the complainant's equipment — you do not even want to see it — you could not care less whether it is the latest from Japan and uses 6 speakers instead of 2. Why should you have someone else's hobby suddenly thrust at you, and be forced to take any interest at all?

The WIA recommendation is, be pleasant, conduct tests when required by the Radio Inspector, and refrain from antagonising anyone. However, do not establish any undesirable precedents by actually repairing or modifying equipment yourself. Record carefully the days you remain off the air by official direction, so you may seek a reimbursement on your licence fee, if tests prove you were innocent of any breach of licence conditions.

Amateur transmitter interference

to tape recorders, record players, electronic organs, etc.

IVOR MORGAN, VK3DH
29 Constance Street, East Hawthorn, 3123

This is a report on a considerable amount of work carried out by Bert Hanson, VK3BAW and the writer. The work is by no means complete as yet but it is considered necessary to supply at least a report in the form of notes only, on the progress.

Introduction in the form of history or lead up to the subject should be quite superfluous so I propose to go directly into the problem.

I have had low level audio frequency valve amplifiers for microphone, record players and later tape decks, but any RF interference resulting in CW clicks clear voice or unresolved SSB, coming from the loud speaker system, can easily be cured.

Since these systems were invariably high impedance low level, design demanded careful shielding to eliminate hum frequencies from nearby mains and power supplies. The shielding also helped considerably to reduce RF detection and all one had to do was to include a resistor of 50 to 100K ohms in the grid lead of the first stage to form, with the capacity of the grid to earth, an integrating circuit. We then no longer had a radio frequency detector in the front end of the amplifier.

Since the introduction of the transistor, two things happened. One, the circuit is so low in general impedance that what we used to call "grid hum" pickup, no longer applies. Second, designers found that shielding was no longer called for.

A smart character once said that "a transistor can do anything a valve can do". This is the understatement of the year. He forgot to add that in addition to the fundamentals that they can both "Oscillate, Rectify, and Amplify", the transistor amplifier is intrinsically wider in pass-band and more readily overloaded and made to detect in a non-linear manner.

Because of these factors, you will have observed that the manufacturers of record players no longer bother to shield the printed circuit boards. With a dynamic cartridge there will be six cascade stages over two printed circuit boards. Four stages including the complementary pair power output stage are usually on one board and a two stage high gain pre-amplifier/equaliser on another board. Neither of these PCBs are shielded as a rule and they are usually fitted to the cabinet in such a way that effective shielding is impossible.

Tape recorders are often not as bad in

this respect as more metal shielding seems to be used. Microphone amplifiers vary a great deal but most of them would suffer interference in the strong RF field of a transmitter.

The manufacturers have stated that the percentage of cases where a very expensive record player or electronic organ etc. will suffer from RF interference is small. This is all very well, but I would like to suggest that if a high gain AF amplifier of considerable power was designed to be immune from RF interference, the buying public would certainly appreciate it. The very expensive speaker cones would not be subjected to a damaging pulse every time the refrigerator starts up or a light is switched, and interference from dozens of other normal electrical appliances would similarly be silenced. The taxi car-phone in your street can also often completely ruin a recording you may be copying or listening to.

Commencing at the beginning, we found that a mains filter should be used. This helps considerably to reduce the spark transmitters referred to in the last paragraph. A simple filter consists of a ferrite toroid in the mains lead to the amplifier power supply. We removed the plug and wound as many turns as possible through a ferrite toroid $1\frac{1}{2}$ inches outside diameter using the original flex lead to the amplifier. Much smaller ferrite toroids were used in pickup leads to the pre-amplifier. Medium sized toroids were used in the speaker leads at the amplifier end of these twin leads. Given a large enough ferrite toroid, both left and right hand speaker leads of a stereo system can be wound on one core since the speaker currents cancel in the toroid but the antenna effect of the speaker leads looks into a considerable inductive impedance, isolating the speaker leads from feeding RF into the amplifier.

Shielding speaker leads is useless, since they are almost always unbalanced and a voltage is introduced on the "hot" side, regardless.

Most commercial amplifiers we found, will not tolerate any capacity shunting the speaker leads as it directly affects the negative feed back loop to the early stage of the main amplifier.

So you cannot put capacitors across the speaker leads nor shield them, nor can you increase resistance as the voice coil is usually 8 ohms and any extra resistance will degrade the amplifier. Hence the ferrite toroids using, if possible, the existing

speaker leads with no increase in resistance or capacity.

We have found that a small ferrite bead (No. 3, up to 28 MHz or No. 4 above), wound with as many as possible turns of 26 gauge enamelled wire, connected as close as possible to the base and in series with the base lead of the pickup input amplifier then followed by a capacitor of 100 pF from base to emitter and a 0.1 microfarad from emitter to earth, works best. If the latter is not possible due to negative feed back at the emitter point, 100 pF from collector to base may be used.

If having used a mains filter, speaker leads toroids, input leads toroids, amplifier input RF choke and by-passes, the system is not free from RF interference, at least it should be much improved.

I believe the amateur should try mains filter and speaker leads ferrite toroids first, if he is "treating" his near neighbour's record player or whatever, for the simple reason that it alone could be effective. You know as well as I do how you could be expected to service "for life" your neighbour's record player if you inserted a choke in the front end with a SOLDERING IRON!

In some cases I believe the only way to immunise the amplifier would be to build a new one in cast metal boxes with lids and all incoming and outgoing leads carried via feed through capacitors. The amateur must not be expected to do this.

Let us hope that very soon legislation will be drawn up which will develop Electro Magnetic Compatibility between the consumer, the amateur and the legislators. It is urgent that practical implementation of legislation for the protection of both amateur and consumer be made.

In the main, it is clear that standards of performance to be expected by consumers of amplifiers must be defined. Manufacturers will have to meet these standards. The technical aspects of amateur equipment and radiations will be defined and standards set.

A qualified technical arbitrator will be necessary, one who is fully informed as to what standards are reached by the amplifiers and the amateur equipment, either home made or of commercial manufacture.

Finally irrespective of what conciliatory body is nominated, any decision made must be legally binding on both parties.

Particularly the amateur must be freed from the stigma of potential civil action, as for instance, "a public nuisance".

EMP - the ultimate EMC problem

JIM LLOYD, VK3CGR
Surgeon Captain S. J. Lloyd, QMS, RAN,
100 Wimbourne Ave., Mt. Eliza, 3930

WICEN operators! — will your Carphone withstand an input pulse of several thousand volts per metre with a rise-time measured in nanoseconds? If not, you will be of little help to your State Disaster Organisation in the event of a nuclear attack.

EMP — the Electromagnetic Pulse generated by the explosion of a nuclear weapon — is now being taken very seriously by designers of military communications and electronic equipment. It was given scant consideration in the early years of nuclear weapon testing, for example in the Monte Bello Islands and at Maralinga in the 1950s, because the electronic instrumentation was almost exclusively based on valves, which are relatively resistant to transient pulse damage.

The advent of solid-state techniques, although bringing so many other advantages as to become ubiquitous and inevitable, introduced a degree of vulnerability into the nuclear scenario that has only recently been fully appreciated. Semiconductor devices, as well as having low tolerance to high-voltage transients, are susceptible to nuclear radiation damage, and the concept of "nuclear hardening" is well established; that is, designing the apparatus to withstand at least as much radiation as would incapacitate its human operator.

This concept is hard to apply to EMP however, as the pulse is lethal to equipment far beyond the range at which human casualties would be caused by any of the effects of a nuclear weapon. In fact the electromagnetic pulse is not any hazard at all to personnel, except perhaps indirectly if you happen to be wearing an implanted cardiac pacemaker (and it won't do your transistorised hearing-aid any good!).

GENERATION OF THE ELECTROMAGNETIC PULSE

A nuclear explosion liberates a vast amount of energy, part of which appears in the form of gamma rays. If the explosion takes place in the atmosphere, many of the gamma photons interact with atoms of the air, in a number of ways of which the "Compton Effect" is most significant for the production of EMP. In this interaction, the collision of a photon with an orbital electron transfers energy from the photon to the electron, imparting additional momentum to the latter and causing it to recoil. The resultant movement of electrons constitutes an electric current and consequently induces a magnetic field.

If the system is balanced, the motion of electrons is uniform in all directions radially from the site of the explosion, the resultant magnetic fields cancel, and no pulse results. In practice, however, a

degree of asymmetry is always present. This is introduced either by the proximity of the ground in a surface or low atmospheric burst, or by the earth's magnetic field in a high-altitude burst. Consequently a net current flows in one direction or another, and a transient magnetic field is produced.

It is to be expected that nuclear weapons would normally be exploded near the ground for maximum destructive effect, but it is nevertheless conceivable that a combatant might deliberately employ a high-altitude burst solely to create long-range EMP and knock out the enemy's communications and weapons-guidance electronics. EMP is no respecter of political affiliations, however, and such action would be feasible only if its initiator could be certain that his own equipment was adequately protected.

QUANTITATIVE CONSIDERATIONS

It is not easy to calculate the magnitude of the electromagnetic pulse to be expected in any particular situation, because of the number of variables involved. On the other hand little experimental data was obtained up to the time of the voluntary ban on atmospheric nuclear testing, no doubt because valve circuitry was still widespread and the significance of EMP was underestimated. Consequently there is not much information available and what there is is highly classified. Perhaps those nations who have defied the test-ban know more about it, but they are not telling.

Nevertheless sufficient information has been released to indicate that electrical failure will occur far beyond the range of mechanical, heat, or radiation damage. At such distances the peak voltage may rise as high as 10^4 volts per metre and the pulse energy may be several tenths of a Joule. It is **probably** not enough to damage a 6AK5 or 6BA6 in the front-end of a receiver, but sufficient to weld the contacts of an aerial-switching relay and certainly to burn-out any semiconductor device, confuse a logic circuit, or wipe a core memory.

The threshold energy needed to destroy most semiconductor devices is of the order of 10^{-3} to 10^{-4} J, but circuit malfunction or memory erasure requires only 10^{-5} J. As the total electromagnetic energy released by a thermonuclear bomb may be as high as 10^{13} Joules, it can be seen that only a very minute proportion needs to be coupled into an electronic circuit to create havoc.

Vulnerable as an individual "black box" may be in itself, connection to power cables or aerial feeders greatly increases susceptibility to the low-frequency component of the pulse; damage may extend to vehicle electronics, land-line telephones, and power distribution systems. A couple of examples have been made public; a very small high-altitude test blew the 8 kV

circuit-breakers on a transatlantic cable; and quite a modest surface burst has damaged power transformers over 160 km away.

PROTECTION AGAINST EMP

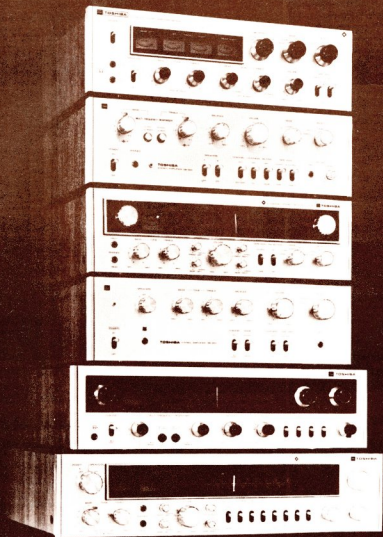
The possibilities of protecting military electronic equipment against EMP has been stated from two viewpoints: one says: "... if nuclear weapons are employed ... then the majority of the Armed Forces involved in the conflict might as well pack up and go home"; the other implies that all that is needed is a bit of screening and filtering. Obviously the truth lies between these extremes, but probably nearer to the former than the latter. Protection is possible but it is expensive and may involve a considerable trade-off in other directions. The extent of filtering and screening that is required is such that retrospective modification would be almost impossible and certainly completely uneconomic. EMP must be given due consideration from the earliest design stages.

Apart from its magnitude, the most difficult characteristic of the pulse to cope with is its fast rise-time of, say, 20 nanoseconds and wide band-width, with most of the energy concentrated in the LF and VLF region. Spark gaps and gas-discharge tubes, as used for lightning protection and in radar T/R boxes, respond too slowly to protect against EMP, although zener diodes may have some application. Screening by copper or aluminium is relatively ineffective against the low-frequency magnetic field, which demands materials of high permeability.

Similarly, the use of RF filters in power supply leads and other external connections is complicated by the low median frequency of the pulse (around 10-15 kHz). Low-pass filters included for TVI and other EMC attenuation are ineffective at the frequencies carrying most of the EMP energy. EMP protection requires good layout design to obviate inductive loops, steel rather than aluminium for cabinets and instrument cases, specifically designed wide-band rejection filters at external connections, good grounding technique, and resonant antenna systems to minimise out-of-band pickup.

To assess the effectiveness of EMP protection, short of resuming atmospheric nuclear testing, it is necessary to use large and expensive simulators. Overseas versions involve such constructions as a cage-dipole antenna 300 metres long and 20 metres high; or a toroidal radiator 45 metres high suspended from a helium-filled balloon. Only laboratory simulators are available in Australia.

Perhaps the simplest answer to the problem for the WICEN operator is to keep that old valve rig in working order, just in case!



MODEL
SB404

MODEL
SB500

MODEL
SA304

MODEL
SB300

MODEL
SA500

MODEL
SA504

**For further amplification
see your local Toshiba dealer.**



TOSHIBA
In Touch with Tomorrow

Distributed throughout Australia by **EMI** E.M.I. (AUSTRALIA) LIMITED.

ick Smi-le

HUSTLER ANTENNAS

Selecting the right antenna is essential for efficient operation of any communications set-up. And it's worth remembering that often the antenna represents only a very small proportion of the cost of a link, yet it has the greatest effect on the overall performance.

The Hustler range is made by New Technics in USA and their antennas have proved popular all over the world. Whether you want fixed or mobile, in any of the bands, there's a Hustler that will offer superior electrical and mechanical performance at very reasonable prices.

All antennas are 50 ohm and require no matching. They all handle the legal maximum powers.

HIGH FREQUENCY ANTENNAS

Fixed station, 4 band vertical Model 48TV covers 10, 15, 20 and 40 Metres with one setting for total band coverage. An optional BOM resonator is also available. No switching no matching and uses only a single leader. Low SWR over very wide bandwidth 1.6:1 at band edges. Heavy duty, low loss mounting brackets. Solid forelocks in turn. Total length 21'6" and weighs 15 lb. Mounts on a vertical support up to 15" OD. \$75.00.

RM80 BOM Resonator rated at 400W PEP adjustable between 2350 and 4000 kHz. 470' long and weighs 1.0 lb. Simply installs on stud of 10 element of 48TV. \$23.90.

Mobile version for 6, 10, 15, 20, 40 and 80M
Basic Mast MD - in the leading mast that features quick interchange of band resonators. Fold down to only 15" above base for ordering storage etc. Simple, economical drive clutch-kick presents optical while in use. 56" long operates as a 15' element in 1/2" OD hard drawn brass and heat treated alloy. Stainless steel base to fit mobile mounts low later. Weighs 1.9 lb. Low SWR and broad bandwidth. \$22.50.



Resonators to extend coverage of MO-1. All precision wound and weather sealed. Adjustable stainless steel top rod and convenient hand side marker plus positive lock nut and clutch. See accessories for special resonator spring.

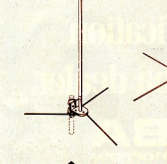
Model	Band	Weight	Price
RM15	15M	0.42 lb.	\$15.90
RM20	20M	0.46 lb.	\$16.00
RM40	40M	0.84 lb.	\$22.50
RM80	80M	1.05 lb.	\$22.90

UHF/VHF ANTENNAS

Fixed Station 2M Colinear GS-144 has an extremely low angle of radiation by combining 3 and 7' wave radiators. Unsurpassed used at 5 db over 1/2 wave ground plane, best experience indicates up to 9 db at distances of 20 miles or more. Directional! Total adjustable. Low SWR, typically 1.1:1 at resonance and only 2.1:1 at 5 MHz bandwidth. 200W FM rating mounts 17" radiators with 21" radius SO239 coax connector, mounts on 1" American standard pipe thread. Ideal Repeater antenna. Weighs 4.5 lb. \$64.00.



6db Gain Two Meter Colinear



Fixed station 2M, 50th wave GS-188 has 3.4 db gain over 1/2 wave ground plane. SWR better than 1.1:1 at resonance and 2.1:1 at 5 MHz bandwidth. Rated 200W. Radiators 47" radius 21" SO239 connector. Unique matching system gives complete bandline absorbing. Supplied with double duty mounting brackets. Weighs 2.5 lb. \$25.40.



SuperGain Mobile GS-144 is a 29' colinear with 5.2 db gain and 200W FM handling. SWR is 1.1:1 at resonance and 1.5:1 at 5 MHz bandwidth. Low angle radiation as with the GS-144. Tempered stainless steel elements. Fits standard mobile mount. 75" long and weighs 1.84 lb. \$37.50.

Basic Base is a 2M, 50th wave mobile, 19' long to install antenna that gives 3.4 db gain over a 1/2 wave ground plane. Fold adjustable for low SWR (1.5:1 at resonance) and 2.1:1 at 5 MHz bandwidth, or better. Stainless steel radiators 31" long. Weighs 2 lb. 100W FM handling. Fits standard mobile mounts. \$17.95.

420-630 MHz two half wave colinear BDL-420 for roof mounting or any flat surface. Requires only a 5" mounting hole. 5.2 db gain. Stainless steel radiators 1' long. Weighs 2 lb. SWR better than 1.5:1. Full 200W rating, complete with 17' of RG58 cable. \$37.50.

27 MHz ANTENNAS

Base station Diamond power gain colinear 27R is made in high tensile aircraft alloy and factory primed. It requires no adjustments. Built in lightning and static precipitation gives Hustler thought of everything when they designed this one. 4 db gain in highest available and effectively doubles radiated power. SWR better than 1.2:1 over full band width. Use only in only 15 minutes to a whopping 20 feet with 9 foot radiators. Weighs 7.3 lb. \$45.00.

Heavy Duty Base station ground plane GPI has telescopic alloy elements and angled radials. One setting for all adjustments. Can be used from 25 to 48 MHz (five element length chart included). Stainless steel ring diameter. 108" long and weighs 2.3 lb. \$24.50.

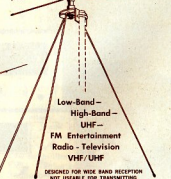
Stainless steel mobile whip SW102 is manufactured in finest 17 7/8" tube ground, polished and tempered stainless steel for maximum resistance to weather etc. No strapping or kitting as with cheaper antennas. Full commercial power rating. 102" long and weighs 1.08 lb. Complete with stainless corona ball and operates at full 1/2 wave on 27 MHz and can also be used on 50 MHz band. \$11.50.

Power Master RM11 resonator assembly is a precision wound, weather sealed resonator with adjustability to low lowest 20MHz and fits the MO-1 (aluminum) and standard fittings. Weighs 0.5 lb. \$16.80.

40-750 MHz Discone DCK is a single large aperture antenna that gives total coverage with excellent match. Very popular with professionals for monitoring all vertically up to 750 MHz. Low band, high band, UHF, VHF, FM etc., right up to 750 MHz. Easy to assemble but use our low loss cable for best performance. Mounts on 1/2" OD pipe or flat surface. Core elements 55" long, dia 20". Weighs 2.5 lb. \$22.50.

Power Master RM11 resonator assembly is a precision wound, weather sealed resonator with adjustability to low lowest 20MHz and fits the MO-1 (aluminum) and standard fittings. Weighs 0.5 lb. \$16.80.

40-750 MHz Discone DCK is a single large aperture antenna that gives total coverage with excellent match. Very popular with professionals for monitoring all vertically up to 750 MHz. Low band, high band, UHF, VHF, FM etc., right up to 750 MHz. Easy to assemble but use our low loss cable for best performance. Mounts on 1/2" OD pipe or flat surface. Core elements 55" long, dia 20". Weighs 2.5 lb. \$22.50.



ACCESSORIES

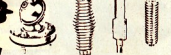
Economy Ball Mount C30 is heavily chrome and 180° adjustable. Exclusive non-slip arrangement in huge 2" diameter ball. Cyclic base for better insulation and lower losses. Complete with Allen key. \$6.95.

Heavy duty spring model C30 handles whip up to 110" long and has standard couplings. Weighs 1.2 lb. \$5.95.

Quick Disconnects GD-1 in 100% stainless steel. Just push and twist to release everyone. Enclosed mechanism prevents dirt jamming. Sets of mobile antennas having standard male/female mounting. Weighs 0.4 lb. \$16.50.

Resonator spring RS82 fits between resonator and Hustler antenna to prevent damage from low flying aircraft etc. Weighs 0.36 lb. \$7.95.

Flat Surface Ball Mount BMD is a commercial quality unit with 2" heavy duty ball joints full 180° adjustment. Gray cyclone base will hold up slight 17° swivelness in flat surfaces. Complete with all hardware. \$17.95.



Track pin mount TLM runs on a sliding rail and has exclusive cable breakers for aerial connections for standard cable and low mounting of all standard antennas. Complete with 17' of cable and PL-259 plug. \$17.50.

Electronics Centre

TRANSCEIVER H.F.

Kenwood TS-520 160W, SSB transceiver covers 80 to 10 metres. Features noise blanker, VOX, DX switch, 5 pole crystal filter, CW filter etc. Has fully transistorised receiver power supplies. This is a really deluxe job in diecast case, not the usual pressed metal construction. Deliveries due in September, but order now as demand will be heavy at **\$550.00** (Road freight extra).



Yaesu Musem FT 101B the famous 160-10 metre, AC/DC transceiver is now available direct from us. Indent price is just **\$525.00** (Road freight extra).



Yaesu Musem FT200/FP100 combination also at only **\$370.00** (Road freight extra).



H.F. RECEIVER

Trio 9R580S 0.5 to 30 MHz receiver is still the ever popular budget priced job featuring product detector for SSB. 240V operated. Only requires speaker. New price is down to **\$152** (includes freight).



POWER SUPPLY

suitable for use with 27 MHz transceivers and IC22. Fully regulated 12V @ 3A from 240V main **\$32.00**

Hi Gain SSB/AM, 23 channels gives 5W on AM and 15W on SSB. All channel crystals included. Features ANL and noise blanker, PTT mike. Operates on 12V dc and has rf output and S meter. Indent price is only **\$200.00** (normal retail is \$275).



Crystals for Pony CB74 and Sideband NC310. Australian PMG approved channels 27.4 MHz (general purpose) **\$8.00** a pair, 27.85 MHz (fishing clubs) **\$7.50** a pair. Other channels are available all at **\$4.50** a pair. Channel 9 (27.065), Ch11 (27.085), Ch14 (27.125), Ch16 (27.155), Ch19 (27.185), also 28.100, 28.200, 28.300, 28.400, 28.500. NOTE each pair consists of Tx on stated frequency plus Rx 455 kHz below channel frequency.

VHF EQUIPMENT

Icom IC22 144-148 MHz, FM transceiver has power outputs of 1W and 10W. The 22 channels all have separate trimmers. Deviation 5-15 kHz. Features solid state Tx/Rx relay, large built-in speaker, MOSFET front end with 5 helical filters, noise cancelling mic, quick disconnect mobile mount. And if the spec doesn't grab you, the looks will. Soft green back lighting, special transmit light and even a light to tell you of incoming signals if the volume is turned down. Supplied complete with workshop manual and accessories right down to a silicone cloth to keep the set like new.



Fitted with one set of crystals for 146.00 or 146.5 MHz (please specify). Normal price is \$245 but we are introducing them at only **\$189.00**, freight anywhere for only **\$3.50** including insurance. Crystals are also available at **\$9.00** a pair as follows:

		Tx	Rx
Old Channels	Channel 1	146.1	146.5
	Channel 4	146.1	145.9
	Channel 8	146.00	146.00
New Channels	Channel 42/45	146.1	146.7
	48/60	146.4	147.00
	55	146.5	146.5

TRANSCEIVERS 27 MHz



Sideband NC310 1W hand-held units. PMG approved. 3 channel capacity. Squelch. External aerial jack. Provision for external supply etc. Supplied with 27.34 MHz crystals (see below) **\$49.75** each.

CB74 Pony 5W, AM, 6 channel capacity but crystals for one channel only supplied (see below). PMG approved and intended for fishing clubs etc. Complete with mic. and accessories at **\$97.50**.

CB78 Pony 5W AM, 23 channel complete with all channels and ideal for the novice licence when it starts. Mic. included for only **\$99.00**.



VHF EQUIPMENT

Ken KP202 146-148 Hand-held transceiver, has 8 channel capacity with 2W output. Telescopic aerial, squelch, provision for external aerial and PL259 adaptor plug supplied. Operates on penlight cells. Crystals included for 3 channels. A very popular unit that we are introducing at **\$150.00** (P&P \$2). Crystals included as follows (please specify):

Alternative A	Tx		Rx
	1	2	3
1 Channel 50	146.5	146.5	
2 Channel 42/54	146.1	146.7	
3 Channel 48/60	146.4	147.00	

Alternative B	Tx		Rx
	1	2	3
1 Channel B	146.00	146.00	
2 Channel 1	146.1	145.9	
3 Channel 4	146.4	146.5	

Special KCP-2 NiCad battery set and charger with 10 cells to suit the KP202 available at **\$35.00**.



DICK SMITH ELECTRONICS CENTRE

Head Office and Mail Orders —
162 PACIFIC HIGHWAY, GORE HILL, 2065
TELEPHONE: 439 5311

Also at —
361 HUME HIGHWAY, BANKSTOWN, 2200



MONITOR SCOPE MODEL SB-610



- Provides accurate Display or Transmitted AM CW
- RTTY Signals.
- Shows signal envelope, A.F. and R.F.
- Shows receiver I.F. envelope with IF's up to 6MHz.
- Operates 160-6 Metres. 15W - 1kW.
- Trapazoid patterns.

\$92.07 plus Sales Tax.

Ex-stock

SCHLUMBERGER INSTRUMENTATION AUSTRALIA (PTY.) LTD.
112 High Street, Kew, Vic., 3101. Tel.: 86 9535.

SCHLUMBERGER INSTRUMENTATION AUSTRALIA (PTY.) LTD.
Suite 7, P. & M. Bldg., 134 Willoughby Road, Crows Nest, N.S.W.,
Tel.: 439 7650.

AUTHORISED DISTRIBUTORS

Digitronics Australia Pty. Ltd.,
12 William Street, Maryville, N.S.W., 2293.
Tel.: 69 2040.

A. Oliver Electronics Pty. Ltd.,
188-192 Pacific Highway, St. Leonards, N.S.W., 2065.
Tel.: 43 5305.

AGENTS—

S.A. Fahey Australasia Pty. Ltd.,
433 Pulteney Street, Adelaide, S.A., 5000
Tel.: 23 4435.

O'Id. L. E. Boughen & Co.,
P.O. Box 135

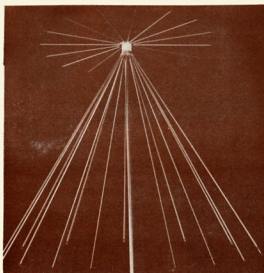
Toowoong, Queensland, 4066.

Tel.: 70 8097.

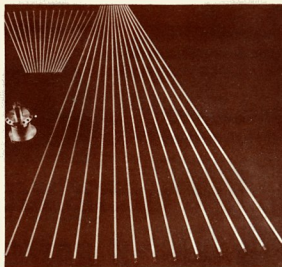
W.A. Dawson Instruments,
70b Hale Road,
Wembley Downs, W.A., 6019.

Tel.: 41-4117.

WIDE BAND DISCONE ANTENNA
SIMILAR TO MODEL IN AR, APRIL
1973, CUT FOR MINIMUM SWR ON
6M, 2M AND 432MHz. DESIGNED
FOR 52 OHM COAX BELLING LEE
FITTING. ALL ELEMENTS PLASTIC
TIPPED. SEAMLESS 5/16" x 16G
TUBING THROUGHOUT



ASSEMBLED ANTENNA
SHOP SALES ONLY



KIT FORM ALL COMPONENTS
EASY TO ASSEMBLE—\$64.75
SHIPPING WEIGHT 7 lbs

RiteBuy TRADING CO

69 Arden St. North Melbourne Tel 329 7618

Audio frequency interference (AFI)

P. W. WATERS, G3QJV

B Gay Bowers, Hockley, Essex, U.K.
(Reprinted from Radio Communication, April 1973)

THE PROBLEM

The current boom in hi-fi sales has led to an increase in the number of cases of interference caused by radio transmitters operating in close proximity to audio equipment. Almost all audio equipment now being produced for the domestic market is entirely solid state and this changeover from valves to transistors has coincided with a hi-fi boom, making it difficult to assess to what extent transistors are responsible for the increase in the number of cases of interference. Certainly transistorised equipment appears to be far more susceptible than the older valve equipment. Also of significance is the now widespread usage of magnetic cartridges which require amplifier sensitivities of the order of 3 or 4 mV. This usually necessitates one or two additional stages of amplification, whereas the older type of crystal and ceramic cartridges having far higher outputs require far less gain from the amplifier.

Unlike television interference, there is usually very little that can be done at the transmitter end to prevent the trouble. Apart from reducing power, moving aerials or switching off altogether, the cure must be at the complainant's end. Like all kinds of interference this poses a social problem. The average cost of a stereo radiogram is around £80-£100, and for a hi-fi installation comprising separate amplifier, speakers, turntable and possibly VHF tuner the price rises to the region of £150 to £200. Any person having spent this amount of money is not going to take kindly to hearing a burst of CW or "distorted" SSB coming through in the middle of his or her favourite record. Unfortunately, telling your neighbour that the interference is not the fault of the transmitter, but his own equipment, is not going to ease the matter even though it is probably true.

Of course, each case has to be dealt with on its merits and no hard and fast rules can be laid down. It is of prime importance to use tact, patience and common sense. A special mention should be made here of the case of interference from an AM transmitter. A sensitive hi-fi system may well be picking up such a signal and relaying it in "full frequency stereo sound" — a situation which calls for special tact.

THE CAUSE

Before discussing the various ways in which this kind of interference can be prevented, it is necessary to understand how the RF signal reaches the amplifier, is rectified, and emerges at the speaker as an unwanted signal. Fig. 1 shows typical audio amplifier low signal stages. In the case of the transistor version notice the base/emitter junction diode and any RF signal that

reaches this stage will be rectified and passed on as an audio signal to the following stages. Similar comments apply to the valve stage. RF energy reaching the grid of the valve is likely to be rectified by non-linear action and the resultant demodulated signal passed on through the following stages as an audio signal. With the modern hi-fi amplifier, having a high overall gain and an output rating of 10 to 15 W/channel or even more, RF breakthrough can be dramatic.

There are a number of paths the radio signal can take to reach the circuitry of an audio amplifier. In high RF fields even direct pickup by the circuit board is possible. Normally, however, the signal is fed to the amplifier via the various connecting cables, which make very good "aerials". Two of the most common sources of trouble seem to be the mains cable and the speaker leads. The mains connection, because of modern ring mains circuits, results in the entire house power wiring being connected to the amplifier and acting as a long-wave "aerial".

As for the speaker leads, stereo reproduction requires a pair of speakers to be separated from the amplifier and turntable unit in order to obtain the stereo effect. In practice this means that the speakers are very often positioned several yards away from the amplifier, the length of twin flex usually used for this purpose making a good "aerial", possibly resonant on or near one of the HF amateur bands. This, of course, ignores the other connecting cables from record turntable, tape unit, VHF tuner etc. It is not surprising, therefore, that a substantial RF signal can find its way into an amplifier several hundred feet distant from the transmitter.

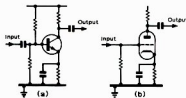


Fig. 1. Typical first stages in audio amplifiers which are open to RF interference, (a) transistor, and (b) valve

THE TREATMENT

There are two basic ways of tackling interference in audio equipment. Either the circuit can be modified to prevent the rectification occurring, or the RF signals can be prevented from reaching the amplifier circuitry by fitting filters to the various connecting leads.

Dealing firstly with the rectification problem, it has already been shown how, in a

transistor amplifier, trouble usually arises when RF reaches the base/emitter junction of a transistor. Similarly, in a valve amplifier, too much RF energy on the grid can also result in rectification. Clearly, if the RF signal can be bypassed to earth without degrading the wanted audio signal then the problem will be solved. The most obvious solution that comes to mind is to fit a capacitor between input and earth of the amplifier of such a value that while it looks like a near short circuit at RF it offers a high impedance to audio frequencies. Unfortunately, between the input and the transistor base or valve grid may be several inches of wire or circuit board, switch contacts with their associated connecting leads and other components. Bypassing at the remote input socket of the amplifier may therefore not be sufficient.

A far more effective method of preventing rectification is to solder a capacitor directly across the base/emitter junction or between control grid and cathode to prevent an RF potential difference between the electrodes.

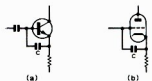


Fig. 2. (a) A suitably chosen capacitor connected between the base and emitter of an early transistor stage will bypass the offending RF to earth without affecting the audio signal. Suitable values are discussed in the text. (b) The analogous modification to a valve stage

Fig. 2 illustrates the required circuit modification. The capacitance value, C , can be around 1,000 pF, although it is by no means critical. The British Radio Corporation recently recommended values of 2,000 pF for one of their transistorised radiograms. This effected a complete cure without affecting the fidelity of the amplifier. Because of the generally higher impedance of valve amplifiers it would be desirable to keep the capacitance value as low as possible and to include an RF choke or 10k ohm resistor in series with the grid to prevent too much loss of high frequencies.

In some cases it will be found necessary to fit bypass capacitors to more than one stage. An indication as to exactly where in the amplifier the rectification is taking place can be obtained by noting whether the level of the interference changes when the amplifier volume control is rotated. Similarly a test should be made to ascertain whether or not rotating the tone controls has any effect on the response of the interfering signal. If the signal is affected by adjustment of any one or all of the controls then the rectification is probably

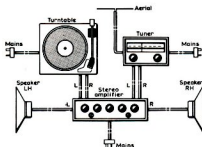
taking place in an earlier stage. The word "probably" is used deliberately. In a recent case investigated, the RF signal was getting past the first stage and being fed to the following stage via the volume control which was acting as a variable attenuator. Although the control affected the level of interference, the rectification was taking place after the volume control. In practice the fitting of bypass capacitors as shown in Fig. 2 usually results in a complete cure.

Once again there are exceptions to every rule. For reasons which are not clear to the author, there has been a case where the fitting of a capacitor across the base/emitter junction has considerably increased the amount of breakthrough. So as an alternative, one or two ferrite beads can be slipped over the base lead of the transistor. However, this can present practical problems if the transistor happens to be soldered very close to the circuit board. In such cases, therefore, an attempt must be made to keep the RF signal out of the amplifier circuitry.

Up until now various ways of preventing RF rectification by modifying the circuitry have been considered, without making any attempt to keep the RF energy out of the amplifier. Very few domestic amplifiers are housed in a sealed metal box, but in a majority of cases the RF signal is introduced into the amplifier by means of the external connecting cables, so this need not be a drawback. For reasons mentioned earlier it may not be desirable to attempt to effect a cure by working on the internal circuitry. If, as an alternative, a filter can be fitted that will either block the path or short circuit the RF signal to earth, then the interference should cease.

The first step is to find out which lead or leads are acting as aerials. Very often this is likely to be a matter of trial and error, but there are two ways in which identification of the offending lead can be revealed. Firstly, with the AF gain advanced, the various signal-carrying leads into the amplifier should be disconnected. If the interference stops or reduces, then the lead concerned is to some extent acting as an aerial and will require attention as detailed later. Obviously the speaker leads and mains lead cannot be disconnected. The second method adopted by the author, very often revealing which of the leads is causing the trouble, is to couple a grid dip oscillator tightly up against each lead and sweep the tuning dial back and forth. The AF gain control on the amplifier should be advanced so that the background noise of the amplifier can be heard from the speakers. If the lead being tested is conveying RF into the amplifier then an increase in background noise in the form of hum or hiss will very often result when the oscillator is brought into close proximity to the lead. For best results the grid dip oscillator should be modulated by a tone. As amplifiers are very often sensitive to certain bands of frequencies only, it is essential that tests be carried out with the grid dip oscillator tuned across the same frequency range as

that from which the interference is being experienced.



Before dealing with the individual leads going to and from the amplifier, a few words regarding the earthing of amplifiers may be in order. Often an amplifier will have a separate earth terminal at the back of the casing. It is sometimes recommended that earthing the amplifier to an earth separate from the mains earth by means of this terminal will help reduce RF breakthrough. Unfortunately the hi-fi installation is very often so situated that a fairly long earth lead is necessary to reach the amplifier. Instead of acting as an earth for RF signals it acts as an extra aerial and will sometimes actually increase the amount of breakthrough by increasing RF energy on the chassis. By all means try the effect of earthing the amplifier but similarly also try disconnecting the earth lead if one is already fitted.

The number of separate cables going to an amplifier in a hi-fi installation can be considerable, the actual number varying with the amount of ancillary equipment in use. Fig. 3 illustrates a typical layout.

It has already been mentioned that each cable can be regarded as being an aerial capable of picking up RF signals and feeding them into the amplifier. Clearly a device is needed that will present a high impedance to RF signals while appearing as a low impedance to audio signals. Inductors and capacitors either separately or together in the form of LC networks readily fulfill just this function. The problem with inductors or capacitors is that the former can be bulky items and both often necessitate cables having to be cut and connectors modified during installation.

In recent years ferrite has become a very popular material for use in combating TVI. In particular, it has been found most

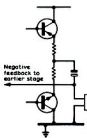


Fig. 4. The normal output configuration of a transistor amplifier incorporates a feedback loop to the earlier stages. Thus any RF picked up by the speaker leads can be fed back to the input stages, where rectification and amplification may take place

useful in preventing RF on the outer braiding of coaxial cable finding its way into the TV receiver. In addition to their efficiency, ferrite cores have the major advantage that the existing cable can be used to form the winding, preventing the need to break the cable. One of the most popular ferrite devices is the ferrite ring, on which a very compact winding can be wound. Because of its shape, the cable is self-securing and the complete filter takes only minutes to construct. As a rule of thumb, as many turns as possible should be wound on to the core, with a minimum of 8 or 10 turns.

For combating RF pickup by connecting cables in hi-fi systems the ferrite ring filter is a very effective device. It can be used on speaker cables, leads from the ancillary equipment and main leads. Usually speaker leads and signal leads from record playing units are small diameter cables, and it is quite possible for a common ring to be used for each pair of leads in the case of stereo installations. The actual grade of material does not seem critical and either rod or ring cores can be used. In the author's case great use has been made of Mullard FX1588 rings. It is most important that the filter be installed at the amplifier end of the cable run and as near to the amplifier as possible.

Ferrite inductors are not the only devices for blocking out RF signals although they are probably the neatest and most compact. If not the cheapest. Coaxial cable substituted for the usual twin flex speaker leads will often help considerably where RF is being picked up on the "positive" speaker lead and conveyed back to the early stages of the amplifier via the negative feedback line. See Fig. 4.

Fig. 5. To combat mild cases of RF pickup by the speaker leads, 0.01 µF disc ceramic capacitors, connected across the amplifier output terminals, can be tried

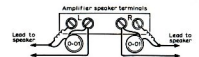


Fig. 6. In cases of excessive RF pickup by the speaker leads a combination of capacitor and inductor can be tried

The use of coaxial cable will also prevent the possibility of RF energy being rectified in the transistor power output stage. This can occur even with the amplifier switched off. The author has had one such case and there have been similar cases of interference to transistorised TV receivers reported. Even the nocturnal operator is not clear of this problem! In cases where the RF pickup on the speaker leads is not too severe the use of 0.01 µF disc ceramic capacitors connected across the output terminals of the amplifier can be tried (see Fig. 5). More effective suppression will be obtained if an inductor is also added as shown in Fig. 6.

However, the use of capacitors or coaxial cable cannot prevent RF currents from reaching the amplifier chassis by means of the "negative" speaker lead. In such cases some form of inductance is needed to choke the RF, and the use of a ferrite ring will be found effectively to filter both conductors if twin flex is used for speaker leads.

RF energy picked up on the mains lead can be a problem whether dealing with TVI, BCI or AFI. The solution is the same for all three types of domestic equipment, and a number of different mains filter circuits have been published. Two circuits are shown in Fig. 7. It is most important that capacitors have an adequate AC rating. The inductors can comprise 18 SWG enamel wire on $\frac{1}{2}$ in. former (wood dowel) 2 in. long. Ferrite rod material (such as an old medium wave ferrite aerial with the winding removed) can also be used and will probably be found more satisfactory for the more severe cases. Where a mains filter is used as suggested above, ideally it should be installed inside the amplifier casing, but with the modern tendency to squeeze as much circuitry into as small a space as possible there is very often no room for the inductors required. If this is so, then the filter will have to be installed externally to the amplifier casing and it is most important to make sure that the unit is completely and safely enclosed so that there is no risk of shock. The advantage of the ferrite ring filter mentioned earlier becomes obvious!



Fig 7. Two circuits for suppression of RF pickup on mains leads. It is important that the capacitors have an adequate AC rating, and if the components are mounted externally from the cabinet they should be well-insulated to avoid any risk of electric shock.

Earlier, the popularity of the magnetic cartridge was mentioned. This in itself has brought about a new problem, although it is only likely to manifest itself in very high RF fields. Because a magnetic cartridge contains a small inductance, it is possible for RF signals to be induced in the coil and conveyed down the inner conductor of the screened cable to the amplifier. Unplugging the cartridge head from the arm will confirm whether or not this is the cause of the trouble. Ceramic or crystal cartridges will not suffer in this way. The solution is a small LC network installed either at the cartridge head or at the amplifier input, see Fig. 8. Care should be taken to select as low a value of capacitor as practicable to avoid reducing the high frequency response. If the network is installed in the cartridge head, adjust-



Fig 8. Cases of RF pickup via the coil of a magnetic cartridge can be solved by a simple LC network, installed either at the cartridge head or the input to the amplifier. The lowest possible value of capacitor should be chosen, to avoid any reduction in the HF response of the system.

ment must be made to the arm counterbalance weight to maintain the correct tracking pressure (often less than 2 gm).

VHF tuners are susceptible to two different forms of interference. The RF energy can either get into the front end of the tuner causing interference to radio programmes only, or alternatively it can be picked up on the VHF coaxial down lead and conveyed back to the amplifier via the chassis of the tuner to cause audio breakthrough. RF energy picked up on the outer coaxial braiding can be prevented from reaching the amplifier either by inserting a ferrite ring filter or using a 1:1 transformer, see Fig. 9. Both are familiar devices for TVI sufferers. If, however, the interference is found to be tunable on the VHF tuner, or only present when it is switched on, then there is a strong possibility that the RF signal is being picked up on the FM aerial and a simple high-pass filter as used for TVI should clear the trouble. The need for the receiver to be provided with an aerial adequate for the area applies just as much to FM reception as it does to TV reception. Normally this means an FM band dipole in the loft or on the roof but in some areas, particularly where stereo reception is required, a three- or four-element beam is needed.

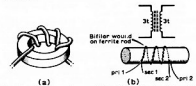


Fig 9. RF pickup on the coaxial braiding of the lead from VHF tuner to amplifier can be cured by either a ferrite ring filter or a 1:1 transformer.

When dealing with cases of hi-fi interference it is essential to realise the importance of keeping all leads as short as possible and this applies in particular to speaker leads. A problem which has given the author some trouble in the past is the re-radiation of signals from one cable to another (TVI sufferers please note). If a lead has had to be filtered then keep it as far away as possible from other leads. Try moving the various connecting leads to the amplifier about in relation to one another and if a number of leads have been taped together try unwrapping the tape and separating them. Very often a speaker lead will be tacked along the skirting board with the mains cable and RF will be induced from one to the other. In the author's case laying the TV aerial coaxial lead next to the speaker leads results in severe audio breakthrough while separating them a few inches completely clears the trouble. Never allow any excess cable to trail over the floor. It should either be shortened or coiled up and taped. The importance of this point cannot be over-emphasised.

THE SOCIAL PROBLEM

There is virtually nothing that the amateur radio operator can do at the station end to prevent causing audio breakthrough, apart from reducing power, unless he is prepared to change his mode of trans-

mission. The latter option has been taken up by a number of VHF operators by switching from AM to FM. The A1 CW operator has the option to change to F1 but this is hardly likely to find much favour on the HF bands and is likely to confuse some operators who may tune to the space instead of the mark. The great difficulty in handling cases of interference is explaining to the sufferer that the fault is with his equipment and not the amateur's. No hard and fast rules can be given as each case is different and personalities and attitudes vary widely. Basically a combination of diplomacy and firmness is required.

The question of whether or not the job of curing the interference is to be undertaken by the amateur concerned is a matter of personal discretion. The author does not favour the idea of carrying out work involving the opening up of amplifiers. This is fine if the amplifier is one's own, but be very careful before deciding to carry out any work on a neighbour's equipment. Really it is a job to be carried out by a paid service engineer, not necessarily because the amateur involved is not capable of doing the work but because anything that goes wrong subsequently is likely to be blamed upon the amateur. If a neighbour does ask an amateur if he would be prepared to carry out the work he should think very carefully before deciding, and if in doubt — refuse.

The question then arises as to who carries out the work. The listener is not likely to have the knowledge to carry out the work himself. He may also be unwilling to pay to have the work done for him if he considers the amateur at fault. Even if he does decide to employ the services of a paid engineer or dealer the time taken up in tracing the trouble is likely to be considerable and many dealers will just have no idea where to start. A major portion of responsibility must be with the manufacturer who designed and made the equipment. In this respect the British Radio Corporation has been found to be particularly helpful. Unfortunately, many manufacturers seem surprisingly disinterested in the short-comings of their equipment although some do provide a certain amount of help and advice in the way of technical correspondence, circuits and perhaps a few components. We therefore find ourselves caught in a vicious circle with an embarrassed amateur and an unfortunate and possibly irate sufferer.

It is hoped that this article will encourage rather than deter amateurs trying to solve their audio breakthrough problems. During the 'fifties and 'sixties TVI has been a big problem, but through the persistent work of the RSGB local groups and individuals the problem has been overcome by many. Audio breakthrough looks like being an even bigger problem to be faced in the 'seventies. The solution is mainly with the manufacturers but it is up to the amateur movement as a whole to make them aware of the problem with a view to persuading them to raise their standards.

INTERFERENCE BIBLIOGRAPHY

Compilation and comments by Peter Dodd, VK3CIF, and Rodney Champness, VK3UG

Good state of the art design and construction practices allied to correct operating of the transmitter or receiver are sometimes not sufficient to prevent interference from raising its ugly head. The following references could be found useful in following references ideas to rid yourself of the problem. The list is by no means complete, but even so does cover more than seventy references. Where necessary explanatory notes are included with the article title.

BOOKS

In the amateur field a must book is the *Television Interference Manual* by the RSGB and reviewed on page 20 of AR May 1973. This book, of course, be read in conjunction with the *PMG's Handbook*, which is at present under examination for revision.

The ARRL's *Radio Amateur Handbook* contains much advice on interference. In the 1974 edition this will be found in Chapter 16 beginning on page 484. In the same edition front and receiver overload problems are dealt with in the receiving system chapter (p. 262).

The *Radio Amateur Communication Handbook* also contains a chapter on INTERFERENCE — Chapter 18 beginning on page 181 with another bit in Chapter 4 — p. 425. Other useful tips can be found in the *RSGB's Amateur Radio Techniques* by Pat Hawker.

Articles from AMATEUR RADIO

Report of the First TVI Field Test. July 56. (Interesting information gained during the early days of TV in Australia).

Anti TVI Filters for the Amateur Transmitter. Nov. 55. (Good design data by Hans Ruckert).

Low Pass Filter Homemade Simplified. Oct. 56. (Follow up article to the Nov. 55 article).

Understanding Television Interference. Oct. 56. (A QST reprint).

Diagnosis of TVI — A system of locating the cause of interference. Jan. 57.

Prevention of Interference by Television Receivers. May 58. (How do we convince manufacturers that this would be a good idea?)

TVI Diagnosis Chart. May 60. (Similar in some points to Jan. 57 article).

Sideband — Visual Monitor. Sept. 60. (A 913 CRO tube in a simple monitor).

AM Without Splitter. Feb. 61. (How to run high modulation level without causing interference).

Recent Trends in Receiver Front End Design. Noise Figure and Cross Modulation Characteristics of Tube and Transistor Front Ends. Jan. 64. (Have you ever wondered why you hear stations that shouldn't be there?)

Considerations in Receiver Front-End Design. March 64. (How to improve the performance of receivers to reject unwanted signals).

Corrosion. March 65. (The effect of dissimilar metals on one another in a salty atmosphere. The same types of things can cause external cross-modulation of your signals and perhaps cause TVI. A corroded TV aerial or rusty fence for example).

Lightning. April 66. (IGNRT — GRNS).

Federal Comment. May 71. (Australian Standards for Electro-Magnetic Interference. May 71. (A few draft interference specifications and E.M.C.))

1974 Easter Federal Convention. June 74. (Section 11 interference. A policy statement well worth reading.)

An Effective Noise Silencer — using a separate noise receiver. April 63. (Good background information. May be obsolete in light of more recent developments.)

Ignition Noise versus Frequency. May 64. (A graphical indication of frequencies worst affected by ignition interference.)

Keeping out of that Modulated Milk Bottle. July 64. (Suggestions on methods of transmitter construction and operation to minimise TVI.)

Some Aspects of Spurious Radiations from Amateur Transmitters (R. Gurr). Dec. 64. (Methods to keep your amateur transmitter clean of HF spurious.)

Some Low Pass Filter designs for Anateurs. April 66. (Three low pass filters for attachment to the output of HF and VHF transmitters.)

Noise Limiter for Mobile use. June 66. (A simple single diode limiter.)

Some Thoughts on Six Metre TVI. August 66. Roy Hartkopf. (Good sound philosophy on public relations as well as suppression methods.)

Interference to Television and Radio Reception by near Radio Communications Transmitters. Nov. 66. Gurr and Murphy. (Traps and filters to be fitted to TV and Radio receivers.)

TVI — It can be eliminated . . . well, nearly always. Aug. 68. (A simple cheap filter.)

A Graphical Method for Locating Interfering Beat and Harmonic Frequencies. Feb. 70. (Of use to find out possible spurious outputs from SSB transmitters.)

Two-Slot Notch Filters for TVI. July 71. (Attenuation of unwanted frequencies by up to 80 db. Applicable to transmitters and TV sets that use coaxial cable feed.)

Tackling TVI. April 72. (Methods of suppression and ideas used in England. A reprint.)

Building Modern Filters. Oct., Dec. 72 and Jan. 73. (Designing filters both AF and RF.)

Television Interference Manual RSGB publication, reviewed. May 73. (A worthwhile addition to your library.)

A Noise Blanker for the Trio TSS10 Transceiver. Jan. 73.

TVI on 6 metres. Jan. 73. (Reasons why you cause TVI, selectivity curves of TV set IFs, etc.)

Constructing a LP Filter. Jan. 73. (35 MHz cutoff filter with 80 db attenuation at 50 MHz.)

Audio Rectification Hints — Interference. Sept. 73. (Keeping out of people's Hi-Fi.)

TVI, BCI and the Irate Neighbour. Newcomers (Notebook). Jan. 74. (Understanding your neighbour. Public Relations.)

Newcomers Notebook. May 74. (Thoughts on shifting the 6 metre net to 53.995 MHz.)

Simple High Pass Filter. March 74. (Similar to the one in Aug. 69 issue.)

Articles from RADIO AND HOBBIES, ELECTRONICS AUSTRALIA

The VHF Bands — what to do about TVI problems. Part 1, 52-54 MHz. May 64.

The VHF Bands — what to do about TVI problems. Part 2, 144-148 MHz. June 64.

Television Interference from Power Lines. March 68. (An extremely interesting article on TVI as caused by power lines and also causes interference to radios and communications services too.)

Lamb tube Noise Silencer using valves. August 69. (A line filter for heavier loads. Oct. 69. (1 KW on BC bands and above.)

Noise Silencers — A development model using transistors. Dec. 69. (Lamb tube noise silencer.)

Suppressing Impulse Interference. A Reader Built. Oct. 70. (Thermostatic Clicks, contactors, etc.)

Easily Adjusted Low Pass Filter. May 71, page 75. (An instructive article on Radio Communications.)

A Power Line Filter. June 71 (BC band and similar frequencies.)

A Power Line Filter. August 71. (Modifications to the unit described in the June issue. Smaller value suppression capacitors.)

E2A20 Communications Receiver. Jan., Feb., and March 70. (An interesting and apparently quite successful Lamb Noise Silencer. Not all Silencers are what they are cracked up to be.)

Toroid filter minimises Radio, TV Breakthrough. June 74.

Articles from ELECTRONICS TODAY INTERNATIONAL

RF Interference. Nov. 71. (A general article.)

Articles from BREAK IN

Ignition Interference in New Zealand. Oct. 70. (BC band and above.)

How to Handle Hi-Fi Interference. Nov. 70. (A helpful reprint from OST.)

Radio and Television Interference from Electrical Appliances. Dec. 73. (An article showing many methods of eliminating interference to receiving equipment caused by electrical appliances.)

Articles from HAM RADIO

Noise Radio-Frequency Interference. Dec. 70. (A general article dealing with a wide spectrum of problems.)

Eliminating Engine Interference. March 74, page 63. (A book review of what appears to be an interesting book that may well be a desirable addition to the mobile amateur's library.)

Arc Suppression Networks. The Ham Notebook. July 73. (For contactors, etc.)

Articles from RADIO COMMUNICATIONS

Cross-Talk. In the beginning, and Start off outside peak viewing hours. July 72. (Public Relations ideas on living with your neighbours.)

Cross-Talk. Friends and Neighbours. June 72. (Public Relations Ideas.)

Cross-Talk. RFI. Can't go it alone. May 73. (Public Relations Ideas.)

Audio Frequency Interference (AFI). April 73. (An extremely interesting and informative article.)

Practical Braid-Breakers using Stock Material. Nov. 72. (More applicable to British TVI problem where coaxial cable feeder systems are used.)

Articles from TELEVISION

Curing RF Interference. Jan. 74. (Similar to the last two Radio Communications articles but attacking the problem from a slightly different direction.)

Articles from POPULAR ELECTRONICS

Electronic Pollution . . . An Impending Crisis. April 73. (A very interesting article on the ever increasing level of total noise. Even country areas are becoming polluted this way.)

Articles from THE FIREMAN

RF Noise and Vehicle Mobile Communications. March 72. (This is a small section of information presented by Mike Russell-Clarke of the Country Fire Authority at an IREE (Aust.) Radio Interference Workshop.)

Articles from QST

Eliminating Automotive Noise by Shielding the Car Ignition System. May 59.

Hi-Fi and Electronic Organ Interference — How to Clean It Up. June 66.

A Noise-Locator Receiver. June 66.

Electrical Interference. Part I — Causes and Identification. April 66.

Electrical Interference. Part II — Tracking and Cure. May 66. (The follow-up article of April 66.)

Recent Equipment — Shielded Ignition Systems. Aug. 64. (A run down on various commercial shielded ignition systems available in the United States.)

TVI is Still With Us. Dec. 66.

Beginner and Novice — How to Handle TVI — Useful information on what to look for. April 67.

Absorptive Filter for TV Harmonics — and a Novel Filter Construction Technique. Nov. 68.

Beginner and Novice — How to Handle Hi-Fi Interference — A cautious approach to a sticky problem. June 70. (This was reproduced in Break in Nov. 70.)

Power Line Interference — Its Causes and Methods of Elimination. July 70.

Beginner and Novice — RFI. July 72. (Designed mostly for those who suffer with AFI.)

Hints and Kinks for the Experimenter. Locating Sources of Man-Made Noise. Feb. 74.

If you count the number of references shown in this article you will see over 70 separate articles listed. It is believed that this list contains more than sufficient information for the average amateur to make a success of clearing up interference.

There are many other articles which have had articles on interference. For the suppression of motor vehicles (including suppressing specific models of cars) probably as detailed descriptions as anywhere appear in *Mobile News* the journal of the (British) *Amateur Radio Mobile Society*. Detailed descriptions of requirements for specialised equipment often appear in publications referring to the apparatus concerned. e.g. for RTTY machines see the *RSGB Teletypewriter Handbook* page 23. There are two firms who may be able to help with information and components for vehicle suppression namely Joseph Hayes (Aust.) Pty. Ltd., of Cheltenham, and Robert Hayes (Aust.) Pty. Ltd., of Clayton, both of Melbourne — there may be branches in other States, however.

Newcomers Notebook

with Rodney Champness VK3UG

44 Rathmullen Rd., Boronia, Vic., 3155

AUDIO FREQUENCY INTERFERENCE — HOW IT HAPPENS

You could be excused for not understanding how a piece of audio equipment such as a Hi-Fi amplifier responds to the RF signal from a radio or television transmitter. The reasons for an audio amplifier responding to RF are simple. A manufacturer should have little problem in making his equipment immune to RF signals if proper tests and corrective action are taken at the design stage. The actual cost of making the equipment RF proof should not increase production costs more than about a dollar per unit. Most manufacturers seem more interested in total sales than in producing an item that a customer will be completely happy with.

In Fig. 1 a typical rudimentary transistor audio amplifier stage is shown. This stage will act as a RF detector if any RF signal which exceeds about 50 mV or so is present on the base lead. Once again you could be excused for saying that this is not possible as the transistor is biased on with a voltage of 0.6 volts between base and emitter. Regrettably 0.6 volts is not the voltage that is necessary to cause this transistor to act as a diode detector instead of a linear audio amplifier. I have deliberately shown this transistor as a high

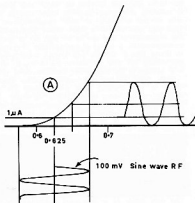
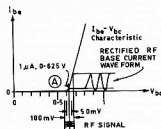


FIG.3. BASE RECTIFICATION. Collector current will vary at modulation rate.

gain type running very little collector current; the base current is very low at 1 uA. The base-emitter junction can be considered as a forward biased diode. A diode of the silicon type requires a forward bias in the region of 0.6 volts to cause it to conduct. In this particular circuit in Fig. 1 the diode (emitter-base) is just turned on with 1uA of forward bias current.

This means that very little variation from this 1 uA current, 0.6 volt forward bias will cause the diode to rectify the signal applied to its base whether it is AF or RF. It is in fact a high impedance very low level audio amplifier and, as such, very susceptible to high level signals of any sort. If, for example, this transistor has a switch on voltage of exactly 0.6 volts and with 1 uA base current the voltage is only 25 mV more than this. It means that signals with a peak to peak level exceeding 50 mV or an RMS level of 17.5 mV will cause this transistor to act like a diode detector — a crystal set! The leads to the base of the transistor should it be in the front end of the amplifier will probably be quite long, up to several feet. These leads usually go via switches and long, sometimes unshielded, leads to the pick up head of the record playing turntable. These long leads are ideal for picking up RF signals from nearby transmitters and in some cases not so nearby transmitters. These signals do not need to be very strong to cause trouble, in the order of 17 mV in this hypothetical case. A broadcast station can easily produce an RF

field of several mV at a distance of several miles. An amateur station at a 100 feet may well induce an RF field of several hundred millivolts. Several hundred millivolts would certainly cause a sensitive AF stage to act like a crystal set detector.

Fig. 2 shows how an audio stage can be RF proofed by the addition of 2 additional inexpensive parts. These two components short circuit the radio frequency component to earth. They form a basic low pass filter, with a loss factor of 3 db at frequencies varying from 150 kHz to 1500 kHz. If R3 is 10k ohms the response of the audio amplifier will be down by 3db at 150 kHz, the response at 1.8 megahertz is down by about 22db, at 14 megahertz the response is down by about 39 db on the audio response. At 14 megahertz the critical level instead of being about 17 mV as in the unsuppressed amplifier is now a figure of something like 1.5 volts. That is some difference. It does help in the first instance if all likely critical leads are shielded so that the actual RF brought into the case of the amplifier is at as low a figure as possible. At times a small ferrite bead worth a cent or two slid over the base lead of the transistor can help considerably to reduce interference pick up particularly at VHF. The ferrite bead acts as an RF choke.

I hope this short article has helped you to understand how AFI suppression is achieved. The suppression of interference is not the impossibly hard job that many people would have you believe. They probably think it is hard because they have not taken the time to really find out how interference is caused, and how it can be cured. There is these days less reason for not being able to fix interference as much more sophisticated equipment is available than previously.

Try This

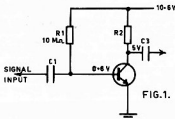
with Ron Cook VK3AFW
and Bill Rice VK3ABP

ANTI-TVI TRAPS

You know (we hope) that your 6 or 2 metre transmitter is correctly modulated and harmonic-free. But the neighbours or the XYL complain of TVI on channels 0, 1, 5A, and perhaps others. Try this very simple, sharply-selective trap which can be fitted to the TV set. The idea is old but there may be newer amateurs who are unaware of it.

Take a length of 300 ohm TV ribbon (between 12 and 20 inches for 6 metres, 3 to 4 inches for 2 metres). Solder the conductors together at one end, and across the other end connect a stable screw-adjusted (i.e. multi-turn) trimmer capacitor. The mica-compression type is not recommended, but may do for 6 metres. Use 3-30 pF for 6 metres, preferably 1-10 pF for 2 metres. This combination of ribbon stub and trimmer forms a very high-Q tuned circuit.

The trap circuit is now coupled into the



TV feeder ribbon (but not connected to it) simply by placing their flat sides adjacent and taping together with a few pieces of PVC tape. The trimmer end of the trap should be near the TV antenna terminals. A possible refinement is to fasten the trimmer physically to an insulating bracket (or the cabinet back, if non-metallic). With the transmitter operating, carefully adjust the trimmer, using a plastic adjusting tool. At one critical setting the TVI should disappear.

These traps are sharp enough to have no effect on TV reception when turned to the adjacent amateur-band frequency. For this reason they do not permit you to QSY far from the set frequency; perhaps 100 kHz on 6 metres. Also they may need periodic readjustment, particularly if the trimmers used are not highly stable. But they do work! Unfortunately, if too many are needed in your vicinity you may also have to reduce power, go mobile, use another band, or shift QTH!

VK3ABP

VHF UHF

an expanding world

with Eric Jamieson VK5LP

Forreston, S.A., 5233
Times: GMT

VK0	VK0RG, Macquarie Island	52.160
	VK0MA, Mawson	53.100
	VK0GR, Casey	53.200
VK1	VK1RTA, Canberra	144.475
VK2	VK2WI, Sydney	52.450
	VK2WI, Sydney	144.002
VK3	VK3RTG, Vermont	144.700
VK4	VK4W/2, Townsville	52.600
	VK4W/1, Mt. Mowbullan	144.400
VK5	VK5VF, Mt. Lofly	53.000
	VK5VF, Mt. Lofly	144.800
VK6	VK6VF, Perth	52.3015
	VK6RTU, Kalgoorlie	52.350
	VK6RTT, Carnarvon	52.900
	VK6RTW, Albany	144.500
	VK6VF, Perth	145.000
VK7	VK7RTX, Devonport	144.900
	VK6VF, Darwin	52.200
VK8	P25GA, Lee, Niugini	52.150
ZL1	ZL1VHY, Auckland	145.100
	ZL1VHW, Waikato	145.150
ZL2	ZL2VHF, Wellington	145.200
	ZL2VHP, Palmerston North	145.250
ZL3	ZL3VHF, Christchurch	145.300
ZL4	ZL4VHF, Dunedin	145.400
	JA 1A1DY, Tokyo	52.500

No advice of any alterations, additions etc. to above list. Everyone must be satisfied, no one complains!

SIX METRES

"The six metre band never closes." So said Rod VK2ZQJ some years ago; seems he has been proved right plenty of times. On 2nd July around 0205Z for about 3 hours band open between VK2, 5 and 7, signals around 58. Strong TV signals from Brisbane on 4/7. On 14th July, open between VK2, 3, 4, 5 and 7, with northern VK4's very strong. MUF well up, probably approaching 100 MHz. Conditions continued into next day again with northern VK4s strong. By Monday 16th, signals had dropped off but still VK4s around. Plenty of Channel 0 activity at odd times throughout the remainder of July, little else heard. Weak CW on 52.050 from VK2 one occasion, riding in and out of the noise, nothing positive, may have been Wally ex VK5ZWW testing!!

Nothing to report on two metre scene. Rod VK2ZQJ still looking for 2 metre M/S contacts, no takers so far.

DAPTO MOONBOON PROJECT

Lyle VK2ALJ sends along his usual information about the workings of VK2AMW. Appears calculations giving a 2 hour time error did not h.e.p. the proposed tests on 22/6/74, with ZESJJ in Rhodesia, and G3LTF.

VK2ZHU recently placed the transmitter cubicle heater box in position in an effort to stop corrosion of relay contacts which has been a source of trouble, and construction of a new transmitter frequency source is proceeding.

The Dapto Group has received advice from the PMG Department that their high power permit has been extended until April 1975, and provision made to cover the use of the F1 and F2 modes (RTTY) in addition to A1 and A3 modes.

G6JP

George Jessop, G6JP, is the President of R.S.G.B. for 1974. Licensed in 1929 as 2AYP and granted a radiating permit as G6JP in 1930, George was one of the pioneers of VHF communication in 1933 and was one of a team which demonstrated the feasibility of VHF air to air and air to ground communication, a factor of considerable importance in World War 2. George has written many articles and books on VHF of which the R.S.G.B. VHF/UHF Manual is but one. (From Break-In June 1974.) Well, that's it for this month. Overall activity close to nil. Closing with the thought for the month: "With man's great ability to think and reason and compute, we can now pinpoint most of our current problems. The trouble is we can't solve them."

The Voice in the Hills.

Y.R.C.S.

with Bob Guthrielet

Methodist Manse, Kadina, S.A., 5554

The July issue of a Newsheet published by the University of NSW Amateur Radio Society gives the names of 20 candidates who have passed the full and limited Amateur Licences. We offer our congratulations to the successful students, and to the Society which is a member of the WIA — Y.R.C.S.

The Newsheet also includes a letter submitted to the WIA the contents of which should be read by Amateurs, not only in NSW but also throughout Australia.

With a population of over 3 million people here in Sydney and with the Youth Radio Club Scheme (Y.R.C.S.) having been established in 1962, one would think that in 1974 there would be thousands or at least hundreds of people actively studying through clubs or correspondence here in Sydney. This is not the case. It's not the fault of Y.R.S. They have an excellent syllabus and guide for clubs and individuals wanting to study. It's up to us all to start supporting the dedicated few at Y.R.S. in an activity which has been long neglected by the Sydney Amateur. We all listen each week of each year to the effort put into Y.R.S. by the Maitland Radio Club in serving the people of that town and district. Yet what are we doing for the people of Sydney? It's up to the amateurs in this city to do something about the situation. We at NSW University have formed an amateur radio club affiliated with the WIA and hope to organise

displays and encourage Y.R.S. courses to be established in local schools, and in our own University. Please give some serious thought as to how you, as an amateur can assist the community. We at NSW University are trying our best but with over 3 million people out there much more needs to be done."

On behalf of WIA—Y.R.C.S. I thank the University of NSW Amateur Radio Society for sharing our aims and concerns.

Commercial Kinks

with Ron Fisher VK3OM

3 Fairview Ave., Glen Waverley, 3150

A HELICAL WHIP FOR THE KEN KP202

If you have trouble getting tangled up in the standard telescopic whip on your KEN, perhaps you might like to try this six inch helically wound whip. Designed by Don Polce VK3ADP, the performance is in every way comparable to the standard length whip.

Before commencing construction of the helical it is necessary to modify the KEN to take a BNC antenna socket as in the previous section. The whip is wound on a section of fibreglass rod, 1/4 inch diameter at the base and tapering to 5/32 inch at the top. The length of the rod should be 5 1/2 inches to allow 5 inches for the antenna plus 1/2 inch to fit into the BNC plug. Winding data for the antenna is as follows. Using 26 gauge enamel copper wire 47 turns are wound close spaced over the top 1 1/2 inches with 15 turns spaced over the bottom 3 1/2 inches.

The actual adjustment to frequency is quite critical, and of course should not be attempted on the KEN. Best connect the antenna through an SWR meter to your old valve transceiver or transistor final that has high SWR protection. The final adjustment will be to less than half a turn at the top of the whip.

When completed, the winding should be coated with an epoxy resin such as "Araldite". The finished job should look like the one illustrated.

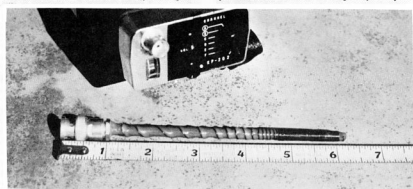
SPURIOUS RECEIVE SIGNAL WITH THE FT27B
With the change to 147.0 MHz for the receive frequency of repeater channel four quite a few FT27B owners have run into trouble with a spurious signal on this channel.

It appears that the trouble is caused by a beat between the second harmonic of the first conversion oscillator beating with the third harmonic of the second conversion oscillator. This occurs when the second conversion crystal is on 10.245 kHz and not on 11.155 kHz as indicated on the FT27B circuit.

Correspondence with Yaesu indicates that they use both frequencies in order to avoid spurious responses on particular frequencies. They do not state however which spurious responses are avoided by using 10.245 kHz.

So, if you are in trouble with the new channel four, check your transceiver and see which frequency the second conversion crystal is on. Do not rely on the circuit as these are all shown as 11.155 kHz. Check the actual crystal.

The cure is to change to 11.155 kHz. It seems that Yaesu might exchange crystals. They have offered to do this in my case, however, I suggest you contact them before sending off your crystal.



Federal Contest Manager,
Box 67, East Melbourne, Vic., 3002

VK4DO	244/261	VK4NQ	120/124
VK3AMK	239/243	VK4LZ	119/123
VK3JVC	238/242	VK3VJ	118/122
VK3HL	234/238	VK3BBB	117/121
VK3DK	228/240	VK6DR	115/118
VK7DK	227/231	VK3APU	110/114
VK3JF	225/230	VK2ZA	109/112
VK6LK	213/216	VK3BCY	108/110
VK3SM	203/210	C21AA	108/113
VK3ALM	200/204	VK2AEB	103/108
VK3TG	198/206	VK3LC	103/107
VK4MY	198/202	VK5Q1	103/106
VK3XM	195/201	VK5ZB	103/107
VK4XJ	182/200	VK6HE	102/104
VK5SB	188/193	VK8KP	102/106
VK5WV	187/182	VK5WD	102/107
VK7LZ	173/184	VK3XD	101/104
VK4FH	161/172	VK4ZK/9	101/104
VK3PD	152/156	VK3SO	100/104
VK4ZJ	150/153	VK4JS	100/102
VK1VP	148/152	VK5CB	100/103
VK3SK	143/148	VK6WY	100/103
VK3JM	139/143	VK2AXI	99/103
VK6CW	139/142	VK2GV	99/102
VK2AGO	137/142	VK3ADO	99/102
VK6KK	134/138	VK3AKZ	99/105
VK4SD	127/130	VK3OR	99/102
VK7VJ	127/130	VK2KJ	99/101
VK4QA	126/130	VK3CR	98/101
VK3QV	125/127	VK3WW	98/101
VK3ZY	121/125	VK2NM	97/100
VK6TW	121/123	VK2AMU	95/103

C.W.

VK3AHQ	308/331	VK4DO	196/218
VK3QL	298/328	VK4SD	187/206
VK3YL	292/315	VK4UC	171/177
VK2APK	291/304	VK5BO	163/181
VK4FJ	290/332	VK3AK	149/162
VK3XB	280/300	VK4MY	147/152
VK3NC	268/297	VK4XJ	147/157
VK4VC	263/268	VK2QK	142/146
VK6RU	262/291	VK2SG	139/146
VK3YD	258/281	VK2AH	137/150
VK4TY	253/272	VK3LH	128/138
VK3TL	248/260	VK3SR	127/133
VK3RJ	245/265	VK3LV	122/126
VK3KS	243/254	VK3HL	116/121
VK4XX	234/239	VK5XK	114/122
VK4RZ	231/252	VK4PK	104/112
VK7LZ	203/229	VK3VJ	101/105
VK3AK	200/218	VK4FH	98/105
VK3JF	199/210	VK8HA	97/101

OPEN

VK4KS	315/339	VK3QV	141/145
VK3RU	315/345	VK4NQ	132/138
VK4SD	314/335	VK3LV	127/130
VK2APK	311/329	VK5Q1	127/130
VK2VN	311/336	VK9LV/GSRV	127/140
VK3ZC	308/335	VK2AXX	125/132
VK4VX	306/312	VK6JK	125/136
VK6MK	302/329	VK3TW	125/127
VK4PK	301/312	VK4LZ	120/124
VK4FJ	300/332	VK8KP	116/121
VK4TY	300/321	VK3APU	112/116
VK2SG	299/309	VK4DV	111/115
VK4UC	297/303	VK9TB	110/114
VK3SG	286/306	VK4BA	108/115
VK3TL	280/293	VK3YS	107/121
VK2AH	273/292	VK6AI	107/110
VK4RF	273/290	VK3AXQ	106/110
VK3NC	269/298	VK4EZ	106/110
VK3ACD	266/275	VK5EJ	105/108
VK3JA	262/289	VK5FY	105/111
VK3JF	256/268	VK3OG	104/107
VK4DO	255/279	VK3SO	104/108
VK3HL	253/268	VK3XD	104/107
VK4KX	238/243	VK8BA	101/104
VK7LZ	233/259	VK2PA	100/112
VK4XJ	223/234	VK1QL	98/101
VK4MY	221/226	VK2AND	98/102
VK6HD	186/191	VK2PF	98/103
VK4FH	183/196	VK8ZZ	98/100
VK3SX	151/157	VK4J	97/100
VK3HE	148/153	VK4QF	96/100
VK6KK	145/151	VK5EF	95/100
		VK3ACS	93/101

Where two stations have the same Current Countries total, the position in the above list is decided by numerical and alphabetical order of the call-sign.

The above list does not include a number of members in whose tally there has been no movement for a number of years.

W.I.A. (W.A. Div.)

RAFFLE RESULT

1st Prize — YAESU TRANSCEIVER
VK2ZZV, G. O'Brien, N.S.W.

2nd Prize — \$60

C. Harper, Balga Balga, W.A.

3rd Prize — Typewriter

VK6EB, F. L. Bradshaw

4th Prize — \$30

A. Pike, Alfred Cove, W.A.

5th Prize — \$25

Morley, Cannington, W.A.

6th Prize — \$25

VK6KY, A. M. Keightley

7th Prize — \$25

D. Patchin, Como, W.A.

8th Prize — Steam Iron

VK6ZK, T. Stanicic

9th Prize — \$20

J. Kitney, Donnybrook, W.A.

10th Prize — \$15

VK7TE, W. Tanner

Letters to the Editor

Any opinion expressed under this heading is the individual opinion of the writer and does not necessarily coincide with that of the Publishers.

The Editor,

Dear Sir,

After the discussion in previous ARs, some may be tempted to try (or be put off trying) direct conversion sets. The following has been based on my experience with this type of receiver, and my remarks should be viewed in the context of VHF and UHF receivers, where noise figure (NF) is a meaningful figure of merit. Low-noise audio amplifiers without transformer impedance matching to 50 ohms have about —70 dBm noise level. Thus a system using a mixer with about 5 dB conversion loss directly following the antenna will have a NF of 5 plus 5 plus 130 — 70 equals 70 dB, since a 10 kHz bandwidth, 5 dB NF system has a noise level of about —130 dBm. Thus gain of 70 dB is required at the signal frequency to attain adequate noise figure. This is not difficult if the stages do not require tuning — though cross-modulation may rear its ugly head.

The direct conversion receiver's real difficulty comes at this stage. The inevitable LO feedthrough caused by imperfectly balanced modulators, an by LO pickup in the front-end, gives a DC signal on the demodulated output. Variations in LO level (due to vibration or power supply) are resolved as audio output, and regeneration is virtually assured unless headphones are used. Even then, microphones are troublesome.

Thus high performance direct conversion receivers are "not on". Similarly, any stage which product detects to give audio must be balanced to minimise microphonics. 40-50 dB of LO suppression should be found adequate.

Chris Horwitz,

81 Prospect Rd., Summer Hill, N.S.W., 2130

The Editor,

Dear Sir,

There is no effective legal provision in Australia for the regulation of radiated, induced or conducted electromagnetic energy from sources other than licensed wireless transmitters, but it must be stated many utilities who are responsible for unavoidable noise-producing equipment do try and co-operate when advised by the PMG's department. The provisions of the Wireless Telegraphy Act and the Broadcast and Television Act control the licensing and conditions of operation of radio communication services in this country. It is difficult to comprehend that statutory powers exist which are binding on licensed operators of radio equipment, but which do not apply to operators of equipment or machinery that cause pollution to the R spectrum. In Australia, as in the USA and the UK, commercial radio transmitters and associated equipment are "type approved" and are licensed subject to the most stringent, almost state-of-the-art specifications. Industrial and medical users can run RF oscillators or diathermy units, with a power of up to several kilowatts. These may be constructed with the absolute minimum of parts, little or no filtering, and can radiate interference for many miles, sometimes thousands of miles. The same with vehicle generated Electromagnetic interference. It was stated (1) at the 1971 IREE workshop meeting (2) on radio interference "It is very evident that the need for a statutory authority exists with the power to lay down standards for the control of unnecessary emissions of noise with at least equivalent standards as are applied to the licensed users of the spectrum". Not only must the emission of 'noise' be reduced, the immunity of appliances and equipment must be increased by regulation. The general attitude of the manufacturers is that until we have approved technical performance standards for equipment with each installation subject to approval and inspection by a government authority (3) no one manufacturer can afford design improvements. We must start treating industrial and commercial radio frequency equipment on the same basis as any other licensed communication service, or we must suffer a steady increasing amount of interference which seems likely to threaten each one of us and other com-

FERGUSON

*Manufacturers of:
Electrical / electronic
equipment, wound
components and
lighting control
equipment.*

BRANCHES IN ALL STATES

**Ferguson Transformers
Pty Ltd.**

Head Office
331 High Street, Chatswood
NSW 2067

PO Box 301 Chatswood,
NSW, Australia 2067

Phone: 02-407-0261

munication services.

In New Zealand it is now a statutory obligation for manufacturers of electrical equipment to limit radiation and interference from their equipment to within certain limits, and a user obligation to do likewise in the event of complaints.

Prevention is better than a cure. In 1934 an 'International Co-operation in the Suppression of Radio Interference' committee was formed called CISPR (4) who have laid down well defined limits as a standard.

Although air pollution is drawing more attention nowadays, prevention of pollution of the ether and of the power supply systems is just as important in a world that will use more and more electric and electromagnetic energy for domestic and industrial purposes. Not all manufacturers, importers, and users of radio and electrical equipment in the past in Australia have exhibited a social conscience. Rules should be made to cover unapproved type or unlicensed radio transmitters, transceivers, and walkie-talkies entering the country by the thousands, and sold to innocent, and not so innocent unlicensed owners or operators.

Why is there this anomaly in regulations, allowed by the government? Earlier this year, responsible amateurs at Federal Level at the 1974 Federal Convention held in Sydney over Easter moved that the PMG be asked to consider the introduction of legislation to require purchasers of radio transmitters to produce evidence that they have a licence for their transmitter.

Let's hope this motion will prove just as successful as the recent WIA Submission to the Independent Enquiry into FM Broadcasting by the VHF/UHF Advisory Committee.

W. George Francis, VK3ASV
(1) See Page 25, Australian Electronics Engineering.

(2) "Second workshop on Radio Interference", March 1971, by Mr. M. Russell-Clarke, of the CFA.

(3) Electromagnetic Interference caused by industrial users of RF generators by MOHDELL, page 250, Proceedings IREE Australia, August 1970.

(4) CISPR — Comité International Spécial des Perturbations Radioélectriques.

The Editor,

Dear Sir,

On Sunday, December 1, 1974, between 6 am and 4 pm Queensland time (no daylight saving), the Brisbane VHF group will hold another field day for its members. In the past when field days have been held during this time of year, it has so happened that other clubs in other parts of Australia have also had field days at the same time. This has resulted in many more contacts for stations in the field, particularly on 6m, and has brought about some real competition. Might I suggest every club in Australia thinking about a field day around this time choose December 1 this year.

Organisers could consider offering more points for channel 50 operation than channel 40, perhaps double points for 432 MHz and up contacts. Distance multipliers to be changed to kilometres from miles, and writing to local Channel 0 stations well in advance to seek their co-operation in not coming on the air until 15 minutes before programme time.

A note to me from each club running a field day that they could help our members pointing beams from their favourite mountain tops.

D. I. Marshall, VK4ZAF

The Editor,

Dear Sir,

Under the heading of equipment reviews could someone write up some of these portable 240V AC generators currently available?

I have heard that some perform well with a steady load but can't handle TX/RX type operation. Also it is said that frequency control of some is quite difficult.

As these units could open up new fields of portable and public service operation, what is the chance of getting some of our members with special skills to test a few of them.

(Any takers? — Ed.)

Editor,

Dear Sir,

As one who is foolish enough to remain in the WIA in the hope that justice may some day prevail, may I express my disgust at the continuing victimisation of the Associate member by the Victorian Division.

While not wishing to dispute the relative cheapness of the \$17.00 proposed for Associate membership from June, 1974, what I do dispute is the nearness of this sum to the \$17.50 required of a full member.

In 1970 the Associates paid the already unrealistically exorbitant figure of 94 per cent of full membership. In 1972 we saw 95 per cent and in 1973 up to 96 per cent. Now we have 97 per cent — and in three years, undoubtedly, the decimal places of 99 per cent.

As justification for the high figure the unbiased council (of full members) reminds one that both amateurs and associates receive the benefits of AR (how much associate based content?), must pay the Federal Levy, the IRR levy, and help subsidise that complexity of three legged fuses which has trouble allotting and collating short wave listeners numbers (but manages to generate accounts). Thus the gap is larger than it seems, so we are told.

On the other side what about the no voting rights for associates, no call book listings, no new member listing in AR, and a low priority for disposals equipment (despite the protests that no bias exists). In other words why should a 3 per cent difference entitle the full member to the extra benefits. (And please don't ask why we therefore don't become full members — some of us are happy just to listen and should be entitled to do so at a reasonable membership cost).

So Victorian full members — be proud of your Council and please, accept our subsidy towards your subscriptions.

P.S.—This is not a stab in the back to the Victorian Executive — they were advised of my feelings in July, 1973 after I discontinued attending the monthly executive meetings.

Brian J. Hannan, WIA 15185
Lot 64, Heroes Avenue,
Emerald, Vic. 3782

FM and 2 m REPEATER DETAILS

The ever-busy George Francis, VK3ASV has sent in a wealth of information (regrettably too much to print . . . Ed.) on his researches into 2 metre channels for his directory.

The details now given are mainly from his material with other data obtained from various sources subsequent to the date of his letter. For channel frequencies see March 1974 AR, page 23.

VK1 Considerable activity going ahead to build their 46/58 repeater.

VK2 (a) Sydney repeater VK2RAS (R1) on old Ch 4 and located at Hornsby (Dural) with 5 minute auto ID. Repeater officer VK2ZPJ.

(b) Hunter river area repeater VK2RAN (R2) on old Ch 4; located on Mt. Sugarloaf 96 km North of Sydney. Repeater officer VK2BSC.

(c) Central Coast repeater VK2RAG (previously VK2AFR/R) on old Ch 1. Located at club rooms Kariong 6 km SW of Gosford. Ident on MCW. Repeater rx operates continuously, if repeater tx is not heard send steady unbroken flutter free carrier for 5 secs. then wait 40 secs. for tx valve filaments to warm up. Tune up signal

facilities available. Auto change-over emergency power supplies. Normally allow ½ sec. for relays to operate before speaking. Auto ID F2 860 Hz. Repeater group VK2ZRG, VK2ZUX.

(d) Orange and District repeater VK2RAO (ex VK2AOA/R) on Mt. Canobolas 146.1 MHz input 145.85 MHz out. Known as "FRED" (Frequently Ridiculous Electronic Device) and first (experimental) repeater in VK. Range up to 160 km. Repeater officer VK2ZKN.

(e) Illawarra repeater (ex VK2AMW/R) on old Ch 1 located (temporarily at Figtree) at Mt. Robertson. 10W o/p. CW ident every 5 mins. Workable from Sydney southwards. Repeater officers VK2AGV; VK2BHY. (f) Mt. Kaputar. Ch 46/58.

VK3 (a) Melbourne repeater VK3WV/R1 on Mt. Dandenong Ch 42/54. 60W o/p. 120 km useful mobile to mobile service area. Verbal ident. Chairman Repeater Committee VK3BX.

(b) Geelong repeater VK3RAG on Mt. Anakle 18 km NNW Geelong. Ch 48/60 25W o/p. 6 min. timer verbal ident. 65 km range. Repeater officer VK3AQR.

(c) Latrobe Valley repeater VK3RAB on Mt. Tassie. 12W o/p Ch 44/54. 160 km range verbal ident. Repeater officer VK3OZ.

(d) Greater Bendigo area repeater VK3RAM (Midland Zone) on Flora Hill (to shift to Mt. Alexandra) Ch 44/54. 10W o/p. 5 min lock-out. Auto ID FSK. Repeater Ch VK3AAA, VK3ACT, VK3ZKV.

(e) Projected repeaters on Mt. William Ch 42/54, Mt. Macedon Ch 46/58 and Mildura Ch 48/60.

VK4 (a) Gold Coast repeater VK4EI/R2 on Mt. Tambourine, 60 km SW of Brisbane, proposed Ch 42/54. 25W o/p. Repeater Gr VK4ZDA, VK4ZFD.

(b) Ipswich projected repeater on Denmark Hill Ch 46/58.

(c) Northern Brisbane repeater project, perhaps on Mt. Cootha Ch 48/60.

(d) Projected Townsville repeater Ch 42/54.

VK5 Adelaide repeater VK5RAD (ex VK5WV/R1) at Crafers near Mt. Lofty. Ch 48/60. 15W o/p MCW auto ident. 5½ min lock-out. Range 80 km mobiles WICEN priority. Repeater Gr VK5ZK, VK5WB. See AR April/May 1972.

VK6 (a) Perth repeater VK6RAP on Tuart Hill. Ch 42/54. CW ident. Range 160 km S, 80 km N. 50 km inland.

(b) Albany repeater on Mt. Barker 50 km N of Albany. Ch 44/54. Southern Electronics Gr.

VK7 (a) Mt. Barrow repeater (NE Tasmania) Ch 48/60 60W o/p. 13 wpm MCW ident. each 2½ min. Lock-out 5 min. Repeater officer VK7PF.

(b) Hobart repeater on Mt. Wellington. Ch 42/54.

(Due to the efflux of time some details may be dated by the time this is printed.—Ed.)

NOTHING NEW

The following extract from
THE ELECTRICAL TRADER
February 1933, has a very familiar
sound.

RADIO INDUCTIVE INTERFERENCE

In some Electricity Supply Undertakings a great deal of interference is experienced from the Electric Supply Mains and the various types of apparatus used in the system. This has been very marked in the recent broadcasts of the Test Cricket.

Interference may arise from a large and varied number of causes. It is an inherent fault in many of the older types of apparatus and systems of supply, in fact, it may be said to be inseparable from these systems.

At the Local Government Association Conference held last month the subject was discussed and the suggestion that the responsibility for interference of this kind should be determined by an Act of Parliament was mooted.

While engineers know quite a lot about the causes of interference from inductive sources, there are still quite a lot that is not known about it and it is manifestly impossible for regulation by law.

In a great many cases the system of supply must be entirely revolutionised if inductive interference with radio apparatus is to be eliminated while in others the fault lies in consumers' apparatus and not in the supply system.

Radio Engineers are working in conjunction with supply engineers to track down the trouble and great progress is being made in this way. Much benefit has resulted to the public supply undertaking from this co-operation, because the interference has shown up faults, which would have cost the undertaking a lot of money, that otherwise would have gone undetected for a considerable time.

The Department which deals with Interference is that branch of the PMG's Department, the Radio Inspector's branch. Any fault or interruption to radio reception should be reported to this department and the trouble will be tracked down.

In some towns local listeners-in have banded together to overcome the trouble and in Lismore there is a "Listeners' League", which has done good work and removed a lot of worry from the shoulders of the local Electrical Engineer and the Radio Inspector's Department, at the same time ensuring for themselves better reception.

The subject of Radio Inductive Interference is down for discussion by Electricity Supply Engineers at their forthcoming Annual Conference in March next. This will form a cross discussion between supply engineers and radio engineers of the Radio Institution. Mr. W. T. Crawford, Radio Inspector, will, it is hoped, also be present.

More good will come from discussions of this kind than from the framing of new legislation which while, perhaps, conferring a benefit on one section will hamper the development of a growing industry. ●

Hamads

FOR SALE

Chart Recorder 3 channel (2 plus timing channel), 5 speeds, 4 inch wide tape, \$50. **SYNC Generator**, Marconi BD637D, \$40. **VK2ZTY, QTHR. Ph: (02) 30 4312.**

FT200, 4 months old, sell \$370 or trade in on FT401, similar condition. **VK4JJ, ex VK4ZHM, QTHR. Ph: (072) 56 2610.**

Colour TV, brand new, all solid-state, 18 in. **PAL-D**. Tuning VHF and UHF (including 430 MHz.) \$600. **Dev VK2ZJZ. Ph: (02) 44 3036.**

ST R. Hills Crank-up Tower, 12 months old, as new, \$120. **G. Stern, c/- P.O. Box 330, Hurstville, 2220.**

AWA Carphones FM TX and RX 70-85 MHz with power supplies. Some cables and Handsets. \$15 as they come off. See L. D. Styles, 8 Somme Parade, Edithvale, 3196. Disabled Radio Amateurs' Club, VK3ZZ.

COSSOR pulse oscilloscope, Model 1065, 15 MHz bandwidth, complete with handbook and two CRO tubes, both faulty, \$55. **Small tape recorder**, ideal for Morse practice and specially adapted for this purpose. Complete with key, oscillator, professionally recorded tapes and earphone, \$15. **VK3AOH, QTHR.**

Nivice 4DD-5 Discrete 4 channel Demodulator, 6 ICs, 6 FETs, 27 transistors. New, complete with manual and test record, \$95 or offer. **Colin Salbeck, VK3ZEF, 71 Enfield Ave., Park Orchards, 3114. Ph: (05) 870 3987 after 19.00h.**

Signal Generator, Marconi FT801A 10-300 MHz, calibrated output, \$160. **R. S. VHF Voltmeter**, \$20. **VK3YAZ, QTHR. Ph: (03) 25 2689.**

Yaesu Ftdx 560 transceiver, excellent condition, with Yaesu SP-560 matching speaker, manual, set spare 6KD8s, \$425. **VK4UG, QTHR. Ph: (072) 84 6098.**

HW 32A Heathkit 20 M. SSB Transceiver with HRA-10 100 KHz Calibrator and Turner 350C MIC. Extra switched x-tal to tune to 14.05. Home brew mains supply. Also 12 volt mobile supply with in-built 12 ohm forward, 100 watt, 1000 Hz. Match 20 M. base loading coil for 12 foot whip, \$170 the lot. **Bendix Freq. Meter LM-7 with 240V supply, \$30, Prop. Pitch Meter, \$30, Ring Test VK3XT (03) 560 0511 evenings.**

AR7, all coil boxes, AC/DC P/S, speaker, alignment instructions, spare tubes, \$60. **Also Pyle Mk III Reporter with x-tal 53.032 MHz, transistor P/S, spare final tubes, \$30, Pyrex Tape Recorder 7 inch reel 719 1P/S, \$10, Commodore TC-459 inc. spare tubes, \$10, VK3ZPN, QTHR.**

60W AM/CW TX, 160M to 10 Mc. **Genov VFO**, 607 final 6L6's mod. Complete, \$25. **VK3CV. Ph: (03) 62 6431, QTHR.**

Pye 374 Solid State 25 Watt FM Transceiver, converted for 2 metres, includes: x-tals for repeaters 1 and 4 and 148.000 Mcs, Caddle and Mike, \$125. Ring 467 2131 bus. hours. **VK3YBE/ET. Pye ranger FM carphone**, converted to 2m. Transistor power supply, 3/12 output. Complete with x-tal, 1st preamp, 5/8 whip and circuits. I think it still works, \$25 or exchange for handful of 40/80m rocks for my type 3 mk 2, or combination of above. **VK3AQJ, 6 Duncan St., Box Hill, Ph: (03) 285 4324 (A.H.).**

62 Transceiver, 2-10 Mcs., 5 Watt output, set contains 12 Volt DC-DC converter, \$55. **VK3EB, QTHR. Ph: (02) 62-1709.**

2m TC1A177 Transceiver, fully converted, mint condition, with x-tals for Ch B, 4 and X, complete with manual. Price \$130 or offer. **Electronic Keyer** with power supply, RF stage (3 tubes) to cover the whole of the 2 m band, with power supply. What offers? **VK2BJK, QTHR. Ph: (02) 449-1508.**

Superior VHF QTH C/W House, Shack and Workshop. Also QYL sized lawn, 12 km south of Adelaide. Available late November, 1974. Enquiries **VK5ZWW, Box 1117, Oranoe 2800.**

Silent Keys

VK2EH

Mr. E. P. HODGKINS

TEO CHANDLER VK4EJ

The members of the Townsville Amateur Radio Club paid a final tribute to Ted VK4EJ on Thursday 13th June, 1974. Ted, a foundation member of the Club and a pioneer of radio in North Queensland will long be remembered by many old timers for his distinctive "fast" on either key or bug.

When Ted finally came on phone on a homebrew SSB rig, he regularly made his presence felt on the "Meatworks Net".

A great number of people were started off in pursuit of electronics by Ted, and a number continued on to make their career in this field.

Ted will be sorely missed, both on the Amateur Bands, and by his friends in Townsville.

QSP

IARU REGION 3 CONFERENCE

The W.I.A. has received notice that the next IARU Region 3 Association Conference will be held in Hong Kong from 4th to 13th March 1975. The theme of this Conference will be the World Administrative Radio Conference, Geneva 1979 and member societies have been asked to submit Agenda items as early as possible.

AERIALS, TREES, DRAIN-PIPES, ETC.

"Fat, heavy people, it is claimed, are better aerials than slim, small ones! Generally the efficiency of the body corresponds to that of a matched, centre loaded whip 1.2m long at 4.2 MHz. Apparently you cannot cut a transmitter to the belly but only to 'other parts of the body'." From Pat Hawker's Technical Topics in Rad. Communications, April '74. Match that one!

AMATEUR SATELLITES

"William Eitel W4RLU/W0UW and Herbert Hoover III W4SPW have generously offered to match, dollar-for-dollar, up to a total of \$25,000, donations to the ARRL Foundation earmarked for use in the Amateur satellite programme. Funds are urgently needed to support the construction of AMSAT-OSCAR 9 which is estimated will cost on the order of \$100,000. The ARRL Foundation, Inc., 225 Main Street, Newington, Conn. 06111 U.S.A. Extracts from AMSAT Newsletter, June 1974.

SATELLITE 1000 AWARD

IARU Region 1 News for April '74 lists 185 winners of the Satellite 1000 Award at 22.1.74. The list included 2 VK7s and 1 VK5, no ZLs, no ZSE or included anyone from Africa except ZETJX. Most interesting though was the listing of 18 JA stations, VU2UJ and 4X4 in the whole of Asia. In the Pacific Area DU1EJ and DU1PDJ are listed as well as KX6HH and 4X4Hs. Almost the whole of the remainder were WA Europeans. Brief details of the Satellite 1000 Award were listed on page 11 of July '78 AR.

WANTED

Incomplete MTR13, and pin connections and data on an EG-651 cathode ray tube. John Lancaster, VK3CZX. Ph: (03) 62 0201 ext. 2486 B.H. or 89 9017 A.H.

455 KHz Mechanical Filters, AM, SSB or CW band-pass filters with or without carrier crystals; prices and specifications to Bill Roper, VK3ARJ, 12 Explorers Court, Vermont South, 3133.

Selsun Receiver or pair of Selsuns. Details to VK6LT, 19 Errinbee St, Riverton, WA. 6155.

Circuit Diagrams and tuning data on ATRC RAAF Transceiver and also Power Supply K1 to suit ATRC. Contact Col Paton, 2 Premier St., Maryborough, Qld. 4650.

TH3 Jr (or similar) and Rotator. Mails. Unit. Radio Club. VK3ATM, QTHR. Ph: Sec. (03) 47 5908 A.H. Loan or buy list. Book or Diagram RAAF sig. gen. TA01C, VK2AJ, QTHR or Ph: (02) 579 5716.

2m Handbuilt Transceiver wanted by new amateur. Details to VK3ZJZ, Ph: (02) 328 4141.

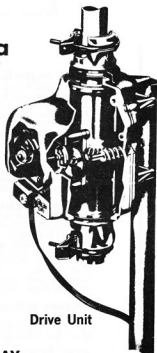
RX General Coverage or Amateur Bands, Miniature tubes. Star, etc. VK3 preferred. A. L. Mac Farlane, Lardner Rd., Warragul, Vic. 3820.

For More Efficient... TRANSMISSION and RECEPTION install a

Stolle

Antenna-Rotator

Now with powerful thrust bearing for greater strength and load capacity. An unrivalled aerial rotating system for TV or Amateur Radio antennas. With a **STOLLE Automatic Aerial Rotator**, accurate and positive antenna positioning in any direction, is right at your fingertips. This allows you to beam your antenna (for transmission or reception) by simply turning the control knob to the desired position, with a full 360° coverage. A STOLLE rotator is rugged enough to handle the weight and wind load requirements of ham antennas up to the size of a normal 3-element 20-metre beam. It can operate for sustained periods of time without thermal overload . . . and with absolute synchronization. Positive disc brake on motor prevents "overshoot". A five-core cable is available to connect rotor to control unit.



R.H. Cunningham
Pty. Ltd.

VIC.: 493-499 Victoria St., West Melbourne 3003. 329-9633. N.S.W.: 4-8 Waters Road, Neutral Bay 2089. 909-2388. W.A.: 65 Balcombe Way, Balga 6061. 49-4919. QLD.: L. E. Boughen & Co., 30 Grimes St., Auchenflower 4066. 70-8097. S.A.: Arthur H. Hall Pty. Limited, 1-3 The Parade West, Kent Town 5067. 42-4506. TELEX: Melbourne 31447 — Sydney 21707 — Brisbane 41500.



Control Unit

Drive Unit

Install a STOLLE Rotator TODAY

YAESU FT-2FB 2M FM



The **FT-2FB** is a compact 12 channel 10W/1W, FM transceiver with squelch and volume controls, panel mounted. The "S" meter is output meter on transmit. Comes complete with built-in speaker, P.T.T. microphone, mobile mounting bracket, power cable and antenna connector. Orders now being taken for supply from current delivery. Price of the **FT-2FB** is **\$198 including three Australian Channels (B, 1 & 4) installed.** Tested, ready to use on 12V DC.

Extra crystals available for other channels. A matching voltage regulated AC power supply, model **FP-2**, **\$59**, incorporates battery charger and large built-in speaker.

Prices include S.T. Freight extra. Prices and specifications subject to change.

All sets pre-sales checked. 90 day warranty and continuing service available only from the Australian agent:—

baill

**ELECTRONIC
SERVICES**

60 Shannon St. Box Hill North, Vic., 3129.

Ph. 89-2213

QLD. MITCHELL RADIO CO. 59 Albion Road, Albion, 4010
N.S.W. STEPHEN KUHLMAN P.O. Box 56, Mascot, 2020

Ph. 57 6830
Ph. Day 667 1650

S.A. FARMERS RADIO PTY. LTD. 257 Angus Street, Adelaide, 5000.
W.A. H. R. PFIDE, 26 Lockhart Street, Como, 6152

A.H. 371 5445
Ph. 23 1268
Ph. 60 4379

SIDEBAND ELECTRONICS SALES and ENGINEERING

YAESU MUSEN TRANSCEIVERS

All in short supply, 50% deposit with orders, average
in delivery 6 to 8 weeks.
FT 101 B AC/DC 160 to 10 M and fan **\$525**
FT/FP 200 combination **\$375**
Spectronics DD-1 counter for 101/401 **\$150**
FT DX 400/560 noise blankers, **\$20**
FT 101/101B/560 CW filters **\$30**

BARLOW-WADLEY RECEIVERS

Model XCR-30 Mk II 500 kHz to 31 MHz
continuous coverage, crystal controlled
reception of AM/USB/LSB **\$225**

HY-GAIN ANTENNAS

14 AVQ 10-40 M vertical 19 feet tall **\$50**
18 AVT/WB 10-60 M vertical 23 feet tall no guys **\$70**
TH3JR 10-15-20 M junior 3 el. Yagi **\$110**
TH6DX 10-15-20 M senior 6 el. Yagi **\$175**
204BA 20 M monoband 4 el. full size Yagi **\$150**
DB 10-15 10-15 M 3 el. Yagi ideal for use
over 204 BA **\$110**
Magnetic base mobile whip 108 MHz up with 18'
RG-58U cable and coax plug **\$18**

ANTENNA ROTATORS

CDR 22-R **\$45**
New HAM-2 with new control box, separate
brake and rotate controls **\$135**

NOISE BRIDGES

Omega TE 01 up to 100MHz **\$25**

EGG INSULATORS the old style porcelain eggs, a
dozen for **\$1.50**

POWER OUTPUT METERS

Galaxy RF-550A with 6 pos. coax switch **\$75**
Swan WM-1500 4 metering ranges 5-1500 W **\$50**

POWER SUPPLIES, 240V AC to 12V DC 3 to 3.5 Amps.
regulated **\$30**

ELECTRONIC KEYS Katsumi model EK 105 A 230V
AC with key paddle **\$35**

CRYSTAL FILTERS 9 MHz similar to the FT 200 ones,
with carrier crystals **\$30**

27 MHz NOVICE LICENSEE & CITIZEN-BAND EQUIPMENT

MIDLAND

5 Watt AM 23 channels, 12V DC transceiver,
all crystals included, with PTT microphone **\$95**

PONY

5 Watt AM model CB-76, identical to the Midland
CB-76 **\$95**

CB-74 5 Watt AM with 27.880 crystals,
for fishermen **\$80**

SIDEBAND NC-310 one Watt hand-held 3-channel trans-
ceivers **\$50**

SIDEBAND NC-501 SSB / AM 23 channel 15W PEP
transceivers, soon here **\$175**

MIDLANDS PRODUCTS SWR-Meters **\$12 & \$16**
PTT dynamic microphone **\$10**

LOW PASS TVI FILTERS, cut-off frequency 35 MHz
6 sections filter **\$18**

144 MHz TWO METRE EQUIPMENT

SPECIAL!!

MULTI-7 solid state 24 channel FM 12V DC operation transceivers, selectable high 10W and low 1 Watt outputs,
receiver with 2 stages FET rf amplifiers ahead of an FET mixer stage, equipped with crystals, all of them, for 3
Japanese channels 144.48, 144.60 & 145.0 MHz, plus TEN Australian channels 40 & 50 transceive, Repeaters
1 & 2 & 3 & 4 plus ANTI REPEATER channels 1 & 2 & 3 & 4!!! Ideal for the travelling man, PTT
microphone and mounting bracket included, all for an incredible **\$225.— ONLY.**

KEN PRODUCTS KP-202 hand-held 2 Watt output transceivers, now with 4 Australian channels, choice of
40 & 50 plus two of repeaters 1, 2, 3 & 4 **\$150.—**

KEN KCP-2 battery charger, KP-202 plugs into it plus 10 NICAD batteries **\$35.—** Genuine leather case for
KP-202 **\$5.—**, Short flexible helical whips **\$6.50**. Crystals for extra channels **\$8.—** per channel, two crystals.

KLM ELECTRONICS Solid state 12V DC amplifier, 12 Watt output, automatic antenna change-over switching
when driven, ideal for the KP-202 **\$50.—**

BELCOM LINER 2 20W PEP SSB 12V DC solid state transceivers **\$250.—**

YAGI ANTENNAS 9 element 10 ft. boom with gamma match coax feed **\$30.—**

All prices quoted are net, cash with orders, sales tax included in all cases, subject to
changes without prior notice. No terms nor credit nor COD, only cash and carry, Govern-
ment & Public Company orders included. Include 50 cents per \$100 value for all-risk
insurance, freight, postage and carriage are all extras. MARY & ARIE BLES, Proprietors.

SIDEBAND ELECTRONICS SALES and ENGINEERING

P.O. BOX 23, SPRINGWOOD, N.S.W. Post Code 2777

TELEPHONE (STD 047) 51-1394